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THE V-22:
CAN THE NATION AFFORD TO FORGO ITS PRODUCTION?

by

Michael Crouch

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Thesis Advisor: L. R. Jones

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The V-22 was designed from the ground up to satisfy missions required by all military services. It is an airplane that represents the leading edge of tiltrotor technology. Since Secretary Cheney's decision to cancel the V-22 in 1989, lines of political competition have been drawn. Continued support for the V-22 comes from an influential group within Congress determined to advance the program based on its civil application. The V-22 no longer represents a purely programmatic issue. It now represents a battle between the Executive and Legislative branches over their specific defense responsibilities. This thesis addresses two primary research questions. First, using the V-22 as a case study, what are the programmatic and financial implications for the Department of Defense and industry of dual-use technology? Second, what does the V-22 teach us about the process of defense budgeting? Throughout the thesis emphasis is placed on

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the actions of the committees of Congress responsible for the defense budget, and specifically the V-22. This thesis examines the roles and relationships between the "players" throughout the history of the V-22 program to determine if any useful analogies may be identified with respect to present and future defense budgeting and acquisition practices.

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The V-22:
Can the Nation Afford to Forgo Its Production?

by

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Submitted in partial fulfillment
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ABSTRACT

The V-22 was designed from the ground up to satisfy missions required by all military services. It is an airplane that represents the leading edge of tiltrotor technology. Since Secretary Cheney's decision to cancel the V-22 in 1989, lines of political competition have been drawn. Continued support for the V-22 comes from an influential group within Congress determined to advance the program based on its civil application. The V-22 no longer represents a purely programmatic issue. It now represents a battle between the Executive and Legislative branches over their specific defense responsibilities. This thesis addresses two primary research questions. First, using the V-22 as a case study, what are the programmatic and financial implications for the Department of Defense and industry of dual-use technology? Second, what does the V-22 teach us about the process of defense budgeting? Throughout the thesis emphasis is placed on the actions of the committees of Congress responsible for the defense budget, and specifically the V-22. This thesis examines the roles and relationships between the "players" throughout the history of the V-22 program to determine if any useful analogies may be identified with respect to present and future defense budgeting and acquisition practices.

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I. INTRODUCTION

A. AREA OF RESEARCH

Universally known as a "political football," the V-22 Osprey is a highly visible airplane at the forefront of defense department budget negotiation over the past several years. Political support for the program is broad. Unfortunately, budget constraints have forced difficult decisions resulting in a cancellation of V-22 production.

The Marine Corps' medium lift helicopter, the CH-46 Sea Knight, is well into its third decade of operation. This factor, combined with Marine Corps emphasis on maneuver warfare, made necessary a decision for an acceptable replacement. During 1983 the Department of Defense informed Congress that the V-22 was designed to perform seven missions, including the medium lift amphibious assault mission assigned to the Marine Corps (Phoncon Bell-Boeing PAO Officer, 1991)[1].

This thesis presents an analysis of the V-22 in financial and budgeting terms. The concept of dual-use technology is explored as part of considering whether this factor is likely to enhance the realization of the V-22 and other potential

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[1] The seven missions that the V-22 was designed to perform are Marine medium lift amphibious assault and national executive transport; Naval strike rescue, special warfare and fleet logistics; Air Force long-range special operations and Army tactical mobility/aeromedical evacuation.

dual-use programs. In describing the legislative history of the program, emphasis is placed on the actions of the committees of Congress responsible for the defense budget, and specifically for the V-22. It also examines the Secretary of Defense's decision to terminate production of the V-22.

B. RESEARCH QUESTIONS

The thesis addresses two primary research questions. First, using the V-22 as a case example, what are the programmatic and financial implications for the Department of Defense and industry of dual-use technology? Second, what does the V-22 teach us about the process of defense budgeting? Subsidiary research questions are:

- How do DoD, Congress, and contractors view the importance of potential civilian applications resulting from V-22?
- Given a declining military budget, should the Department of Defense continue programs such as the V-22 to sustain the industrial base?
- What are/were the roles and relationships between the military departments, the Department of Defense, the contractors, and Congress in budgeting for the V-22?
- What are the programmatic implications resulting from the political competition between the Secretary of Defense and Congress and other interested parties in financial terms, and in terms of decisions on the future of the V-22?

C. DISCUSSION

Many factors influence Department of Defense acquisition decisions. First, the top line Department of Defense budget is programmed for reduction; therefore, fiscal restraint is

the reality of the future. Second, high visibility, high dollar value programs that have not yet begun production have been subjected to unprecedented scrutiny. Considering these factors, the prudent question to ask is, what can be safely trimmed and what should be retained in the Department of Defense budget?

Marine Commandants' General P.X. Kelly and General A.M. Gray have testified before Congress that meeting the Corps' medium lift needs represents a top priority. The V-22 is an airplane designed and built by Bell-Textron and Boeing, that among other applications, will support Marine Corps medium lift requirements into the 21st century. The V-22 takes off like a helicopter, tilts its rotors situated at the wing tips, and flies horizontally like a turboprop airplane.

Tiltrotor technology resulting from the V-22 could have a substantial civilian "spinoff" effect. Broadly known as dual-use technology, the processes and knowledge gained in building the V-22 could positively and substantially impact the design of an airplane for civil application. So promising is this "dual" application that the V-22 has gained global attention.

The V-22 came into the political spotlight in 1989 when Secretary of Defense Richard Cheney cancelled funding for the program. His decision was motivated by a shrinking Department of Defense budget and advice that less expensive alternatives (different mixes of upgraded conventional helicopters) could be funded to meet the Marine Corps medium lift requirement.

Currently, Congress has appropriated funding for V-22 research and development (R&D) and procurement. However, previously budgeted procurement funding has either been reprogrammed or cancelled by DoD. Four V-22 prototypes continue operational testing to satisfy contractual requirements.

Since DoD made the decision to cancel the V-22, political lines of competition have been drawn. Officially, the Department of Defense and some members and staff in Congress recognize the capabilities of the V-22 but believe, given the current budget environment, that the program is not supportable. Yet, Department of Defense resistance may be softening. The "tiltrotor coalition" opposes the decision to cancel the V-22 program. This grass roots coalition consists of members of Congress, public officials, contractors, and retired military personnel. Both sides in this resource competition are powerful.

The V-22 has broad political support partly because components are manufactured in nearly every state in our union. Also, the V-22 provides an alternative to congested national airspace - a concern at both the metropolitan and federal levels. The global competitive environment has little tolerance for technical inefficiency. Fortunately, the United States is the preeminent leader in tiltrotor technology. The view has been advanced that before reducing investment in this

technology and losing its economic potential, production of the V-22 deserves more thorough review.

D. SCOPE OF THE THESIS

Briefly, the evolution of tiltrotor capabilities and the importance of the V-22 are presented as background. With respect to the V-22, the thesis familiarizes the reader with dual-use technology and its application within DoD. The thesis analyzes in detail program budgeted funding requested for the V-22 by the Department of Defense and approved by the House and Senate Armed Services Committees (HASC, SASC), the House and Senate Appropriations Committees (HAC, SAC), and the final amounts approved in congressional conferences. The thesis also describes the relationships between the Department of Defense, Congress, and the V-22 contractors.

E. METHODOLOGY

Data has been obtained from documents provided by contractors, military officials, and authorities within the V-22 technology coalition. Periodicals, articles, and documents from both public and private institutions have been studied. Interviews with knowledgeable personnel at NPS, military program officials involved with the V-22 program, V-22 contractors, congressional staffers, and other experts provide essential input by validating material contained in this thesis. Finally, congressional testimony was examined in

detail to test the financial and other questions investigated in the thesis.

F. BENEFITS OF THE THESIS

Examining the V-22 in terms of dual-use technology places this issue within the current defense policy context. Department of Defense acquisition instructions now require the evaluation of dual-use technology, as an acquisition strategy, in supporting documentation for all new systems. While budget data on the V-22 are a matter of public record, no document comprehensively consolidates and explains budget competition over the V-22 in the policy and political context. Implicit in the budget data are political assumptions and decisions that became apparent when compared and contrasted. Further, the V-22 as a case study may be used in future instruction and research programs at the Naval Postgraduate School in the Acquisition & Contract Management and Financial Management curricula.

II. V-22 OVERVIEW - 1958 TO THE PRESENT

A. PURPOSE OF CHAPTER

This chapter analyzes the utility of the V-22 and explains in detail why the acquisition of the airplane is thought to be crucial to the Marine Corps inventory. The mystery of tiltrotor technology, evolution of the V-22 program including characteristics, capabilities, and enabling technologies, and a brief summary of the contract is provided as background information. Finally, a program and budget status update is furnished to set the stage for the remainder of the thesis.

B. ARGUMENTS TO EXPLAIN WHY THE MARINE CORPS WANTS THE V-22

The Marine Corps is in the waning stages of a modernization block for its warfare hardware and doctrine to sustain fruitful operations well into the future. New jet airplanes (FA-18, AV-8B), light and heavy helicopters (AH-1W, CH-53E), and amphibious ships (USS Wasp class, LCAC), have been added to the inventory in the past decade. The final requirement to complete this modernization block is for a major system acquisition to replace the distinguished CH-46 Sea Knight - the Marine Corp's current medium lift assault transport helicopter.

Wars and the battlefields on which they are fought are dynamic. Historic battles, fought along relatively stable and

lateral lines, provide the military professional with points of reference. However, the probability of future conflicts of this nature may be waning. According to a Marine Corps publication on warfighting:

> If we are to win, we must be able to operate in a disorderly environment. In fact we must not only be able to fight effectively in the face of disorder, we should seek to generate disorder for our opponent and use it as a weapon against him. (FMFM-1, 1989, p. 10)

Hence, Marine Corps doctrine seeks to create, and then fight effectively in chaos.

The two styles of warfare common to all combatants are warfare by attrition and warfare by maneuver. An attrition style of warfare, by definition, is protracted, costly, and probably will not be popular in the United States due to the casualty rate.

> Because we have long enjoyed vast numerical and technological superiority, the United States has traditionally waged war by attrition. However, Marine Corps doctrine today is based on warfare by maneuver.... (FMFM-1, 1989, p. 30)

Maneuver warfare emphasizes speed and initiative. An aggressor seeks to shatter an opponent both physically and mentally. Shock, surprise, boldness, and the creation of relentless stress for the enemy are the commander's tools of maneuver warfare.

Speed is relative. A force possessing speed over an opponent gains, by default, an additional weapon. This was recognized by Sun Tzu:

> Speed is the essence of war. Take advantage of the enemy's unpreparedness; travel by unexpected routes and strike him where he has taken no precautions. (FMFM-1, 1989, p. 16)

War combines a human and physical element. The physical element is controllable, while the human element can only be "influenced" by the leadership at hand. Given the violence and finality of war we must seek every opportunity to enhance our probability for success. Fortunately, the United States has a long history of successful development and exploitation of military hardware. Through continued advancement of technology our nation's combatants will be able to maintain this advantage on the battlefield. "We must stay abreast of this process of change, for the belligerent who first exploits a development in the art and science of war gains a significant, if not decisive, advantage." (FMFM-1, 1989, p. 14)

The Marine Corps organization for warfare centers on the Marine Air Ground Task Force (MAGTF). Task organizations consist of air, ground, and combat support units. These expeditionary units are composite to the situation at hand. Relying on speed and shock ability, they are completely self contained.

The notion that "a team is only as strong as its weakest link" applies to the hardware necessary to support maneuver warfare. One can only speculate on the outcome of the 1980 mission to rescue American hostages in Tehran had the V-22

been available[1]. The American hostage rescue operation involved multiple airplanes, and was to span 35 hours in duration. By comparison, a single V-22 airplane could have completed the operation in eight hours. The "weak" link was hardware. However, it seems likely that missions analogous to the Tehran rescue attempt will confront the Marine Corps in the future.

C. WHAT IS A TILTROTOR?

Helicopters, the precursor to tiltrotor airplanes, encountered limited and somewhat experimental use during the later stages of WWII and the Korean conflict. Their use became prevalent, if not imperative, during the Vietnam war. Since then engineers have sought to combine the advantages of Vertical/Short Take-Off and Landing (V/STOL) with the speed and efficiency of turboprops. Experiments fell into the categories of tiltwings, tiltrotors, tilt-ducts, and compound autogyros. (Thornborough, 1990, p. 2)

A tiltrotor is a hybrid airplane that can take off, hover, and land like a helicopter. Additionally, by tilting its wingtip rotor stems (nacelles) forward, it can fly like a turboprop airplane. It combines the attributes of helicopters (low speed, hovering ability, good stability/controllability,

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[1] LGen. Keith Smith, USMC (Ret), gives an account of V-22 applications under warfare situations in his article, "Potential Value of the MV-22 in Desert Shield/Storm Examined," Amphibious Warfare Review, Summer 1991.

and safe autorotation in the event of power loss) with the attributes of a turboprop (high speed, altitude, and relative efficiency). In short, a tiltrotor is a turboprop airplane that does not require a runway. (Norwine, January/February 1990, p. 40)

To understand where the V-22 fits into the scheme of modern aviation, we may compare on a continuum of hover efficiency, the modern helicopter (most efficient) and the AV-8B Harrier thrust jet (least efficient). The V-22 is close to the helicopter followed by the tiltwing concept and then by the vectored thrust airplane (Harrier). (Norwine, January/February 1990, p. 41)

D. EVOLUTION OF THE V-22

During the 1950's, tiltrotor technology made significant advances with the development of prototype airplanes such as the Bell XV-3 and the Boeing VZ-2 tiltwing. These airplanes looked like a cross between a horror movie mutant insect and the erector sets one used to assemble "contraptions" with as a child. In December of 1972, NASA and the Army contracted with Bell and Boeing to develop two prototype airplanes. (Ryan, 1990, p. 4) The Bell-Boeing effort produced the XV-15, a true tiltrotor airplane. In 1979, the XV-15, the precursor to the V-22, made its historic maiden flight. (Thornborough, 1990, p. 4)

Late in 1981 the Under Secretary of Defense (Research and Engineering) sent a memorandum to the service secretaries suggesting that Marine assault, Air Force special operations, Army electronic warfare, and Navy search and rescue could best be done utilizing mature technology, such as a derivative of the XV-15. By December of the same year, the Deputy Secretary of Defense formally established the Joint Services Aircraft Program (JVX). (GAO, 1986, p. 2)

The year 1982 proved a busy year with respect to V-22 developments. First, the Joint Technical Assessment Group (JTAG), "concluded that the application of tilt rotor technology offered the best potential for a common multi-service aircraft" (GAO, 1986, p. 2). Concurrently, in anticipation of a potential government contract, Bell Helicopter Textron, headquartered in Fort Worth, Texas, and Boeing Helicopters, headquartered in Philadelphia, Pennsylvania, formed a teaming agreement. Next, the Army, Navy and Air Force signed a Memorandum of Understanding (MOU) for the JVX program designating the Army as the executive service, with a Marine colonel as the program manager, and committing $167 million in FY-84 funding (Army $78 million, Navy $70 million, and Air Force $19 million). (GAO report, 1986, p. 3) For reasons detailed in a subsequent chapter, the Army later withdrew as the executive service.

In September of 1983 (FY-84), the Defense Resources Board (DRB) approved continuation of the JVX program with the Navy

to receive full program funding (Research and Development) in its Total Obligation Authority (TOA). During 1984 the Secretary of the Navy selected the name Osprey, after the marine bird of prey that can both swoop and hover (Thornborough, 1990, p. 4). In January of 1985, the Osprey was designated V-22 Osprey. The Bell-Boeing team began Full Scale Development (FSD) during 1985; however, it was not until the following year that the $1.8 billion contract was officially awarded. On March 19, 1989, the V-22 flew for the first time. (Phoncon Bell-Boeing PAO Officer, 1991)

Facing a dramatically decreasing defense budget, the Secretary of Defense decided to cancel the V-22 program in 1989 and the Administration subsequently submitted a FY-90 budget with zero funding for continuation of the program. During December of 1989, Deputy Secretary of Defense Donald Atwood instructed the Naval Air Systems Command[2] (NAVAIR) to cancel $330 million of appropriated funds for V-22 long-lead advanced production contracts, many already in progress. Since then, an increasingly interested Congress has continued research and development (R&D) funding for the completion of six prototype airplanes[3]. (Thornborough, 1990, p. 35).

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[2] The Naval Air Systems Command is the program sponsor for the V-22.

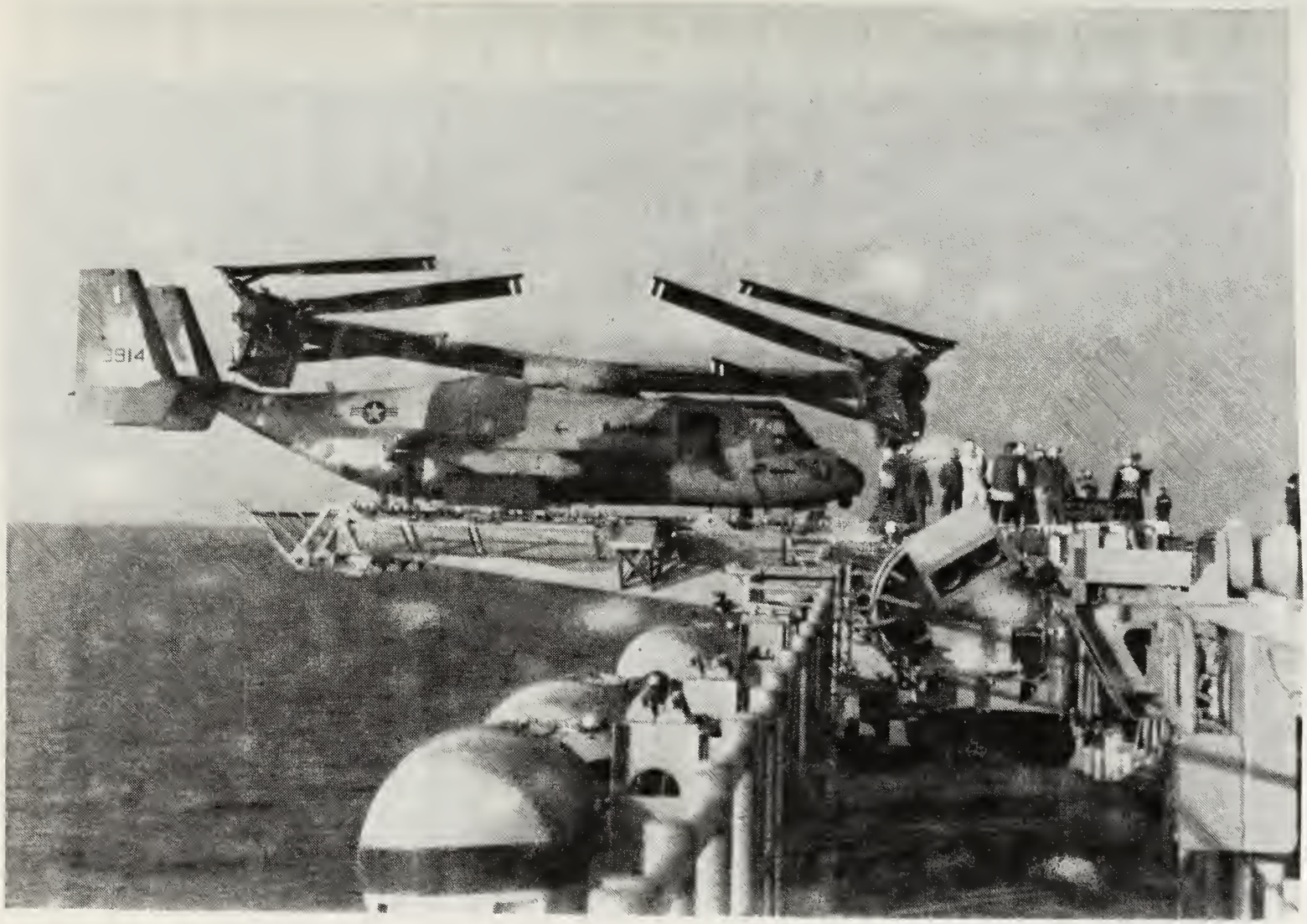
[3] Until the recent crash of plane no. 5, production on the no. 6 plane had been suspended in an effort to conserve available funding (Ferber, 1991, p. 7).

Appendix (A) gives the reader a thorough chronology of events associated with the V-22.

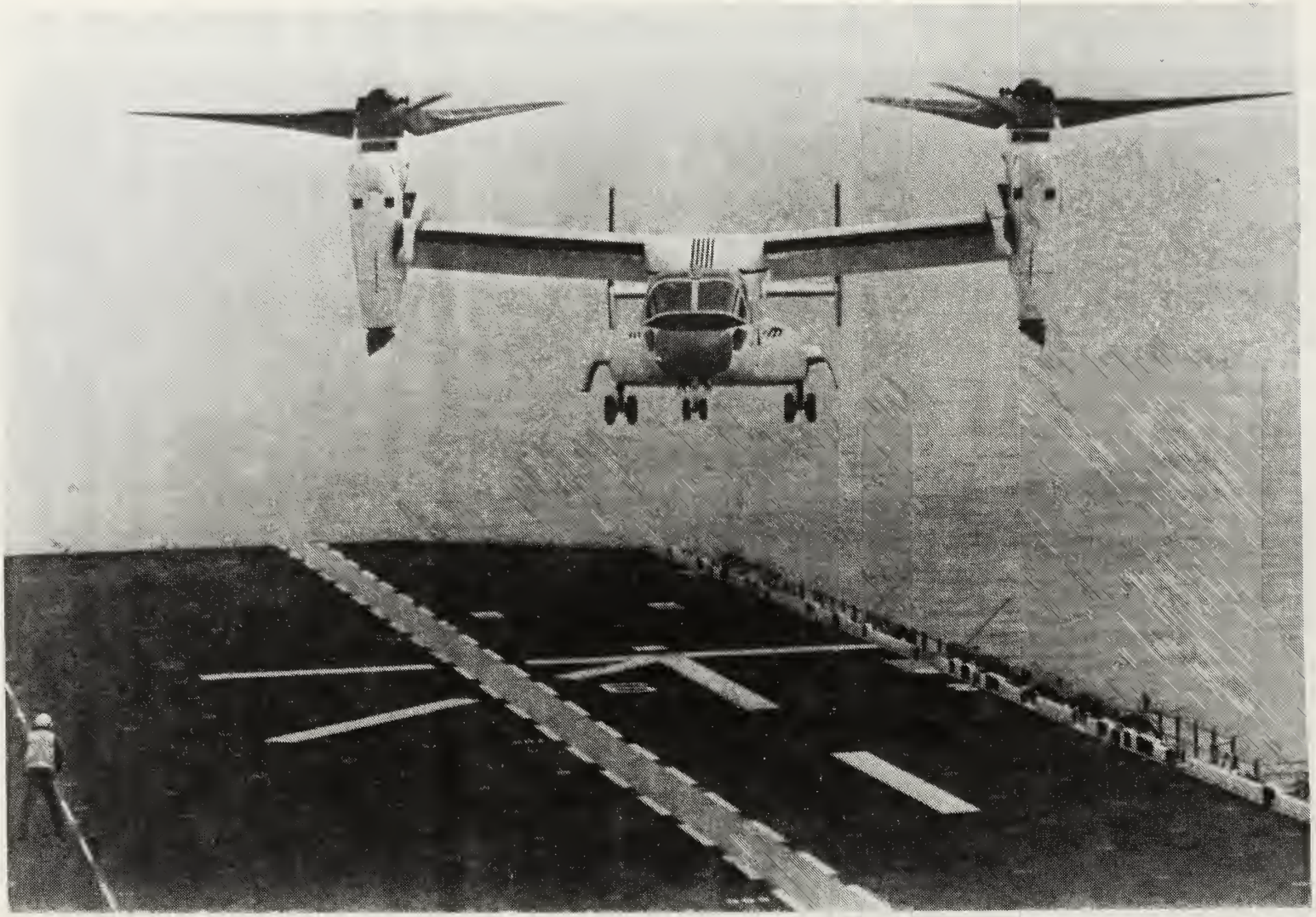
1. Performance Characteristics and Capabilities

When loaded with its full complement of 24 combat equipped Marines, the V-22 can fly 500 nautical miles (nm), 2100 nm dry, at speeds over 275 knots. The airplane is self-deployable and can respond globally within 36 hours, where upon it can go immediately into action without ensuing maintenance. (Ryan, 1990, p. 10) The V-22 can lift three times its own structural weight, i.e., it can carry as much as 20,000 pounds internally, or 15,000 pounds from two external cargo hooks (Arnold, Tripp, 1990, p. 8). Also, when fitted for a secondary mission of in-flight refueling, the V-22 can carry enough fuel to keep four AV-8B Harriers flying for an additional hour.

The V-22's Primary Flight Control System (PFCS) controls cockpit operations, one of three enabling technologies, providing all the necessary flight information to control the airplane and prevent any potentially dangerous maneuvers. The pilot obtains the "feeling" of flight control via stick and pedal force; however, PFCS does all the work (Thornborough, 1990, p. 22). An additional safety feature includes lubrication to the transmission for 30 minutes if hydraulics fail. The engines are connected by a drive shaft that automatically engages if one engine fails.



V-22 PROTOTYPE NO. 4 CONFIGURED FOR STORAGE. USS WASP (LHD-1), DECEMBER 1990.



V-22 PROTOTYPE NO. 3 HOVERS OVER USS WASP (LHD-1), DECEMBER 1990.

Additional enabling technologies include fly-by-wire control and the composite materials that make up the V-22. In novice terms, fly-by-wire means a myriad of tiny wires replace pulleys, pushrods, and hydraulic lines for increased safety and reliability. The primary fuselage contains more than 90% epoxy graphite. This provides a corrosion resistent, ballistic tolerant, durable and highly survivable airplane.

The V-22 is specifically designed for ship board operations. For example, automatic on command, the rotors fold horizontal to the wing, and then the entire wing rotates 90 degrees, providing a compact stowing size of approximately 18 by 62 feet (Thornborough, 1990, pp. 12-13). Also, as pilots typically land on a ship from the left (port) side, the pilot's position on the V-22 is shifted to the right side of the airplane, allowing an unobstructed view upon approach and landing.

E. CONTRACT SYNOPSIS

The three principle contractors working on the V-22 are Bell Helicopter Textron, Boeing Helicopters, and General Motors-Allison. Components for the V-22 come from 2250 subcontractors located in 47 states (Ryan, 1990, p. 5). Bell is tasked with flight testing prototypes numbered one, three, and six (Arnold, Tripp, 1990, p. 3). Additionally, Bell is responsible for the wing, nacelles, drive, propulsion, and rotor systems.

Boeing is tasked with flight testing prototypes numbered two, four, and five (Arnold, Tripp, 1990, p. 3). Boeing is also responsible for the fuselage, landing gear, flight controls, and avionics. Compatibility is ensured through the establishment of a Joint Project Office (JPO) and through Interface Control Documents (ICD's) that provide very detailed interface requirements. Combined the Bell-Boeing team has over 60 years of tiltrotor experience (Arnold, Tripp, 1990, p. 16).

General Motors-Allison is tasked with providing the power for the V-22. Derived from the T56 turboprop, a pair of T406-AD-400 turboshaft engines will provide the V-22 with 6,159 shaft horsepower (Thornborough, 1990, pp. 13-14)[4].

The Bell-Boeing team was surprised by the anomaly presented to them when the Secretary of the Navy directed that the Full Scale Development (FSD) contract be changed from Cost Plus (CP) to Fixed Price (FP) in 1985 (Phoncon Bell-Boeing Supervisor Naval Requirements and Marketing Director, 1991). At that time the contractor had invested $85 million of company resources in anticipation of receiving the award and to prevent scheduling delays.

Historically, CP contracts exceed both anticipated cost and schedule (Smith, 1989, p. 1). Secretary Lehman, seeking to avoid the perennial battles with Congress, especially given

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[4] The T56 turboprop is the engine that pushes the Lockheed C-130 Hercules and P-3 Orion.

the plentiful number of self-proclaimed contracting experts on the hill, felt tiltrotor technology had matured enough to reduce government risk. Therefore, he directed the use of a FP type contract for the V-22 program. A FP contract would force both the program manager and contractor to conduct a thorough review of proposed specifications. (Smith, 1989, p. 9) Ironically, the General Accounting Office determined that the V-22 program should be considered high risk[5]. Current Department of Defense acquisition instructions (DODI 5000.1) would appropriately assign a program given this designation to a CP contract.

By returning to the original acquisition strategy additional insight on this issue may be garnered. The Navy anticipated that more than one contractor would compete during the preliminary design phase and expected to award the contract by a competitive wind tunnel "fly-off" (Smith, 1989, p. 7). Sikorsky gave serious consideration to submission of a proposal but pulled out at the last moment. The commander of the Naval Air Systems Command made the following comment:

> As to why no other proposal was received, it can only be surmised. Even with the expansion of the initial effort to 23 months work, other industry management may have perceived that the Bell-Boeing's lead and prior experience with tilt rotors was insurmountable. Even though NASA's complete tilt rotor data package had been made available, they apparently felt that, without a further expansion of the effort, i.e., 33 months, the probability of winning

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[5] A high risk is associated with events that require rescheduling of higher manpower application to prevent an impact on production schedules or cost (GAO report B-240825, 1990, p. 6).

> was low. The Bell-Boeing team had put their company resources at risk and formed working teams while the program was still in the formative stages. No one else made comparable commitment. (GAO report, 1986, pp. 7-8)

Unable to obtain additional sources (i.e., competition), the Navy sought to control costs through a FP contract. Unable to recover invested resources, Bell-Boeing was committed to the project.

In retrospect, however, the decision may be viewed from two sides. For the Navy, given the political environment at the time, a FP contract provided the best alternative to avoid early cancellation of the program. However, a FP contract defeated the theoretical purpose of FSD, for if acquisition personnel knew how to write specifications for a developmental program then FSD would not be needed. (Smith, 1989, pp. 38-40)

> The management of business operations and technical development programs becomes more complex as technology advances. It is virtually impossible for any one individual - or any one contractor - to comprehend every aspect of research, engineering design, and production stages of a major acquisition program. (Fox, 1988, p. 10)

F. STATUS UPDATE

Military department requirements for the V-22 program have decreased for a variety of reasons, mainly due to budget constraints. Original requirements and related primary missions are contained in Table I. (See TABLE I.)

TABLE I: ORIGINAL V-22 REQUIREMENT (Ryan, 1990, p. 6)

Service	Airplanes	Purpose
Marine Corps	552	Combat Assault
Navy	350	ASW Warfare/CSAR
Army	231	LR Combat Support
Air Force	80	SOF
Total	1213	

Since these original requirements were established, military departments have reduced or eliminated their involvement in the program. Currently, the total number of V-22's expected in the defense inventory is just over half the original requirements. (See TABLE II.)

TABLE II: CURRENT V-22 REQUIREMENT (Ryan, 1990, p.6)

Service	Airplanes	Purpose
Marine Corps	552	Combat Assault
Navy	50	CSAR
Air Force	55	SOF
Total	657	

Note that the Army, the original executive service, has withdrawn from the program.

A senior executive within Bell Helicopter summarized the Secretary of Defense's decision to cancel the V-22 as follows:

> ... Our Secretary of Defense is loudly proclaiming that the V-22 is too expensive for the military. And in the next breath, he defends the B2 bomber, which carries 20 times the unit cost of a V-22 and only 1/1000th the probability of being needed. (Norwine, January/February 1990, p. 39)

Several members of Congress also have expressed concern over the V-22 decision. The House Armed Services Committee directed the Secretary of Defense to provide with the FY-91 budget request an independent Cost and Operational Effectiveness Analysis (COEA) of all reasonable V-22 alternatives (Cooper, 1990, p. 4). The House and Senate Defense Appropriations Conference added additional guidance.

The Secretary of Defense's original decision to cancel the V-22 was supported by an analysis performed by his Assistant Secretary of Defense for Program Analysis & Evaluation (PA&E), Doctor David Chu. Doctor Chu proposed a mixture of CH-53/CH-60 helicopters that would provide equal lift capability for less up front cost than the V-22 program[6]. "The DoD's decision to cancel the V-22 was based on the difference between the $33 billion Cost Level I for 502 tiltrotors versus

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[6] The V-22 will cost more over the next five to ten years than the alternative helicopters because of start up costs.

the $24 billion Cost Level II for the OSD's proposed substitute mix" (Bell-Boeing Press Release OJ-1, 1991).

The Institute for Defense Analysis (IDA), tasked with performing the independent COEA, studied Cost Level I and II, and determined that a smaller fleet of V-22 airplanes would be superior to the Cost Level II package (Simmons, et al., 1990, 11). The study found that

> the V-22's speed, range, and survivability advantages could enable even the 356 aircraft fleet to be more effective - sometimes significantly more and other times only slightly more - than all the proposed helicopter alternatives in each of the four Marine missions examined. Moreover, the fleet of 356 V-22's yields substantial improvement over the Marines' current capabilities for all missions. (Simmons, et al., 1990, p. 11)

The study concluded that

> at the production rates initially proposed for the V-22, its higher procurement cost would make it more expensive over the near term than would be the case with any of the helicopter alternatives considered in the assessment. However, if a lower production rate were to be used and the V-22 procurement stretched out over a longer period of time,[7] then the near-term, costs for the program would be comparable to those for any other alternatives. (Simmons, et al., 1990, p. 23)

Despite these findings, the Secretary of Defense's decision to cancel the program remained. The evolution of the program has reached an impasse between the Department of Defense and those in Congress as well as other influential

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[7] Because the production facilities for the V-22 have not yet been built, they could be designed to accommodate a lower production rate than had been previously planned. Consequently, it should be possible to avoid the unit cost increases that occur when fixed overhead costs must be spread over a smaller production lot. (Simmons, et al., 1990, p. 23)

parties who support the program. The Marine Corps still wants the V-22 but has had to defer to DoD officially.

III. DUAL-USE TECHNOLOGY AND THE V-22

A. PURPOSE OF CHAPTER

The V-22 represents revolutionary technology, principly because tiltrotor airplanes do not require a runway and can fly horizontally like a turboprop airplane. This feature gives utility of application to both the military and commercial sectors, i.e., dual-use technology. This chapter provides information on dual-use technology, a major factor cited by members of Congress as responsible for their continued support for development of the V-22.

Using the V-22 as a case example of dual-use technology provides insight into the following questions: what are the programmatic and financial implications for the Department of Defense and commercial industry of dual-use technology? What role does the Department of Defense play in maintaining the industrial base? Finally, how do the Department of Defense, Congress, and contractors view the importance of potential civilian applications resulting from V-22 technology?

B. DUAL-USE TECHNOLOGY

Quotations by three distinguished observers explain dual-use technology in general, and tiltrotors in particular:

> "History must record that we took charge of our destiny and left a new generation with a better environment, a higher quality of life, and greater opportunities. To

achieve this goal, transportation and transportation policy can be - must be - a vital agency for change." President George Bush (NASA Phase II Final Report, 1991)

"We [must] promote technologies that have a useful application in commercial industry as well as in defense applications, so the overall cost of new technology is affordable to both sectors." Senator Sam Nunn (Bell-Boeing MV-1, 1990, p. 2)

"I am convinced that the tiltrotor is coming without question. Whether it will be an American-made tiltrotor, there is some question...If we build it, we will become the only supplier of this thing five years ahead (of the Europeans and Japanese), and we become an exporter of this technology. It's going to help our balance of payments; it's going to help with our industrial base...What we don't want to happen is for this technology to go the same way as the videocassette recorder technology, which was an American invention. We're buying them all from Japan now, it would be a shame if that happened to the tiltrotor." Jim McDaniel, Senior Federal Aviation Agency (FAA) Official. (Bell-Boeing point paper, 1990, p. 2)

The final quotation summarizes the opinion of V-22 supporters in Congress.

Of the many budgeting and programmatic concerns confronting Congress, decreasing the defense budget while still maintaining a viable industrial base looms high on their priority list. For a variety of reasons, e.g., reduced threat, expanding entitlements and interest on the budget deficit, the United States must reduce its defense spending. The Department of Defense finds itself spending more dollars for fewer airplanes, ships, and tanks (Alic, 1989, p. 2). Also, based on the latest national security strategy, the United States will rely increasingly on reconstituted forces, augmented by a surge capability. Dual-use technology furnishes one strategy for maximizing waning resources that

our elected leaders and senior defense executives have considered. Commitment in Congress to dual-use technology is strong. Legislation proposed by Senator Jeff Bingaman in the FY-92 Senate defense authorization bill would, "...require the Department of Defense to devote a larger portion of its research to 'dual use' technologies that have applications for both commercial development as well as defense" (Rubin, 1991, p. 2090).

Defined in simple terms, dual-use technologies find applications in both defense systems and commercial products[1]. Gerald Epstein, a notable authority on dual-use technology, expands on this definition by stating: "We mean not only artifacts that can be found in both weapons systems and commercial products but also the underlying knowledge base, analytical techniques, technical processes, and design and manufacturing experience by which we apply our knowledge to solve problems" (Epstein, 1989, p. 4).

It is crucial for the reader to understand that a military V-22 has no real commercial application. "It is not possible to merely repaint or tweak the military V-22 to produce a commercially viable tiltrotor aircraft" (Bell-Boeing MV-1, 1990, p. 1). What the V-22 will provide to commercial aviation involves the further development of the processes for

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[1] Two terms, subsets of the general definition of dual-use technology, are "spin-off" and "spin-on." Spin-off includes technology transferred from defense to the commercial sector. Spin-on includes technology transferred from the commercial sector to defense.

tiltrotor technology and an incentive to change our national aviation infrastructure[2].

Caution must be observed relative to the effective use of dual-use technology; it requires a policy of tailoring this aspect of acquisition strategy to each individual program. Programs encompassing dual-use technology often involve dynamic systems on the "cutting" edge. Therefore, to quantify the value of dual-use technology or apply a "template" policy based on prior experience does not exploit its full potential. (Carter, 1989, pp. 5-6) In short, dual-use technology is not applicable to all systems the Department of Defense proposes to develop. Ashton Carter, of Harvard's Center for Science and International Affairs, Harvard University, told the House Armed Services Committee that "the key aim of policy in this area is to make the defense and commercial technology bases mutually reinforcing..." (Carter, 1989, p. 1). Gerald Epstein supports the philosophy advanced by Ashton Carter, stating, "no matter how much some may wish government to adopt the practices of the private sector...there are fundamental and inherent differences between the government and the private sector that may prevent substantial integration of the defense sector with the rest of the economy" (Epstein, 1989, p. 8).

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[2] The term "infrastructure" refers to the network of capital facilities, i.e., airports and vertiports, within the National Airspace System (NAS). A vertiport is a small facility, approximately four to six acres, built to accommodate tiltrotor planes.

Differences between the military and commercial variant of the V-22 are significant. The V-22, designed for military application includes hardening for battlefield survivability[3], a capability for shipboard operations (rotating wing assembly), and military unique avionics. By contrast, the civilian derivative would include an upgraded transmission (a safety feature required for FAA certification), modified cabin accommodations (again safety/comfort related), civilian-unique avionics, and a fixed wing assembly. These modifications are not all-inclusive, but they provide an appreciation of the fact that the commercial derivative is not a clone of the military airplane. (NASA Phase II Final Report, 1991, p. 27)

C. HISTORY OF DEFENSE SUPPORT FOR COMMERCIAL INDUSTRY

The next three sections are not directly applicable to the V-22. Their purpose is to inform on issues confronted by Congress, the Department of Defense, and defense-commercial contractors. These issues include problems with our defense acquisition process and economic vigor both at home and overseas.

Before the V-22 and dual-use technology, the Department of Defense had a long history of advancing technology that, directly or indirectly, energized the economy and enhanced

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[3] A contractor news release linked survivability to saving taxpayer money: "The V-22's speed and maneuverability...makes it up to five times more survivable in combat situations...The Osprey is built to go in harm's way; the alternatives are not."

national security. Computers, jet engines, helicopters, and airplanes representing state-of-the-art technology, firmly secured the United States as the undisputed leader in "high-tech," and contributed to an enduring positive trade export. Department of Defense sponsored research and production has had a persistent impact on our economy as epitomized by the following example:

> Techniques developed for producing firearms earlier in the 19th century laid the groundwork for mass production of sewing machines and bicycles, and for the automobile industry and all that followed...Little more than 40 years after the first electronic digital computers were put to work calculating artillery firing tables, there were more processors than people in the world. (Alic, 1989, p. 2)

For the past century, the federal government, and the Department of Defense in particular, assumed a leadership role to encourage, support, and produce "revolutionary" technology.

The magnitude of research, in terms of financial contribution by the Department of Defense, staggers the imagination:

> ...Taking account of only the defense R&D budget probably understates the portion of the national effort that is military-related. If one combines direct DOD and DOE defense contract R&D, ...Independent R&D and Bid and Proposal expenditures in private industry, and if it takes estimates made by economists of the amount of private R&D investment aimed at winning military business, the total defense-related investment probably adds up to almost half of the total annual national investment in science and technology. (Carter, 1989, p. 2)

Since the 1950's several unsettling trends have interceded in the relationship between defense and commercial industries. Domestic industry has found itself increasingly subject to

foreign competitors. Inexpensive labor and modern facilities have provided foreign competitors with a distinct competitive advantage. Also, the Department of Defense must rely with discomfiting frequency on the commercial sector for products and services for which it set the standards. The problem for DoD with relying on the commercial sector is that the desire to conduct business is not always mutual. (Branscomb and Pratt, 1989, pp. 1-5)

This section does not explain the many factors leading to the current dilemma, although it provides provocative background. A once congenial relationship between the Department of Defense and commercial industry has succumbed to the pressure of global competition and excessive federal regulations. These barriers to effective integration of defense and commercial industries are featured in the next section.

D. THE CURRENT STATE OF DEFENSE-COMMERCIAL RELATIONS

In terms of a global market, U.S. products cost too much, and take too long from concept to production. In short, much of American industry is fighting for its economic life. (Alic, 1989, p. 2)

In the past, commercial industry enthusiastically supported the "performance first" philosophy desired by the Department of Defense (Carter, 1989, p. 6). Today, there is parity of technology between defense and commercial firms.

Therefore, commercial industry may apply discretion as to whom they'll conduct their business with, i.e., domestic firms, foreign firms, or the Department of Defense. The decision to remain predominantly in the defense business is a gamble. Unfortunately for the Department of Defense, many contractors now exclusively prohibit business with the government. Unfavorable risks and excessive bureaucracy simply outweigh the benefits. To illustrate:

> Between 1982 and 1987 the number of US firms making DoD hardware fell from some 118,000 to under 40,000, most of the losses (and consequently increased DOD dependance on imports) in the lower contracting tiers. Project director J. Blackwell of CSIS (Center for Strategic International Studies) predicts mid-sized firms will keep shifting from military to commercial business, and prime contractor will have trouble finding subcontractors. (Aerospace Daily, 1989, p. 266)

Finally, to illustrate a waning DoD presence in advanced technology, consider the following fact: "...Private firms now out-spend the military on R&D by 50 percent and match the government's total R&D investments" (Branscomb and Pratt, 1989, p. 3).

Healthy technology transfer requires government policies that foster conducive relationships, e.g., relationships that result in a tiltrotor airplane that has utility for both civilian application and the Department of Defense. Yet, other factors suppress government-commercial interaction. These barriers include government accounting and auditing practices, strict (i.e., inflexible) military specifications, a fixation by the Department of Defense on unlimited data

rights, defense procurement regulations, and security issues related to technology breeches. The barriers then reduce, prevent, or intimidate an increasingly larger portion of the commercial sector from seeking government contracts. To comply with administrative and legal regulations, contractors determined to deal with the government must segregate their business into defense and non-defense operations, a "luxury" undertaken with decreasing frequency. (CSIS Study, 1991, pp. i-vii)

Dual-use technology carries a price tag. This can lead the taxpayer to question the merit of government-sponsored dual-use research and procurement. Dual-use technology provides its greatest benefit to our nation indirectly (e.g., federally sponsored university research), a factor not particularly appealing to an American public hungry for tangible proof of their tax dollars at work (Carter, 1989, p. 7).

It would be impossible to cost out the financial benefit resulting from dual-use research that is sponsored by the federal government. Still, Americans would notice the impact of dual-use products if daily amenities taken for granted were suddenly absent. Consider the economic impact of the following successful defense-commercial partnership:

> ...(NASA) worked with a Massachusetts-based company to develop a process that allowed a reflective metal film coating to be applied to different materials. The process had applications within the space program, but it also had commercial applications from which this company was able

to profit. The result? The company, which started in 1964 with 16 employees and annual sales just under $100,000, today employs 55 and has annual sales around $20 million. (Manheim, 1990, p. 19)

E. MAINTAINING THE DEFENSE INDUSTRIAL BASE

The Department of Defense has always played a role in determining the industrial base. Factors such as a declining defense budget and the potential for a "peace dividend" seem destined to upset the traditional role played by DoD. Therefore, it seems reasonable to question the degree to which the Department of Defense or the federal government is obligated to sustain the industrial base. Answers to this question invoke broad debate. Also, as noted in the previous section, commercial industry may not embrace development and production of defense systems with the vigor of previous endeavors. Obviously this is a complicated issue compounded by the rapidly changing geopolitical environment.

Still, a market for defense hardware will exist well into the future. Also, the Department of Defense, for national security purposes, will be required to identify and retain critical defense related industries. Therefore, some dependency will continue despite the apparent divergent paths of defense and commercial industry. Gerald Epstein testified before the House Committee on Government Operations, Subcommittee on Legislation and National Security:

"The Department of Defense finds itself attracting increasing attention -- much of it self-generated -- as

> the possible or principal agent for revitalizing our commercial technology base. This attention is in part due to DoD's historical role in pioneering advanced technology...And there is always the lure of what Professor Lewis Branscomb calls the 'Willy Sutton' theory of industrial policy, with the Department of Defense being 'where the money is.'" (Epstein, 1989, p. 3)

Ronald Fox, a notable authority on defense acquisition, summarized succinctly the defense-commercial relationship:

> Since the earliest days our nation, the military forces have relied on private enterprise to supply the material, equipment, and services needed in peace and war. Although the government has always manufactured some war materials - especially ammunition - at no time have the armed forces been fully independent of the private sector in meeting their needs. (Fox, 1988, p. 11)

These two quotes underscore the abiding reality that the defense and commercial sectors are inexorably linked. John Alic, a member of the Dual-Use Technologies Project at the Kennedy School of Government, Harvard University, furnishes the following solution for maintaining and enhancing the defense-commercial relationship:

> It seems unlikely that DoD will be judged the right and proper vehicle for supporting U.S. R&D and technology development. But by ending the isolation of the defense industry from the rest of the economy, dual-use policies could provide and produce cost-effective military systems during a time of severe budgetary strain. (Alic, 1989, p. 12)

Earlier, it was cautioned to avoid viewing dual-use as a panacea. Commercial industry concentrates on efficiency and competitiveness. The Department of Defense concentrates on capability, performance, and the protection of national security assets. (Epstein, 1989, p. 8) Frequently, these

different approaches collide, preventing any meaningful interaction. Ashton Carter notes:

> ...There may be instances where dual-use is not practical, either because technical goals of defense and non-defense are not similar enough, or when it is not practical to surmount the non-technical (read political) barriers. In these cases segregation might be the wisest policy for both sectors. (Carter, 1989, p. 8)

There is little evidence that dual-use technology is an important factor in Department of Defense acquisition strategy. Dual-use technology, in the context of acquisition strategy, does not "play" well at the Department of Defense. It is a "micro" issue in a "macro" process. This results from the long-term orientation of dual-use policy and the short-term focus of DoD on programs and dollars. (Phoncon Bell-Boeing PAO Officer, 1991) In short, dual-use technology is a convenient attribute for a defense system but not a crucial selling point (Boeing PAO Officer, 1991)[4].

F. CONGRESSIONAL INVOLVEMENT

Despite a diminishing role as a global high-tech leader, the United States remains the unquestioned pacesetter for advanced aviation technology. Domestic aerospace industries recorded a global trade surplus of $20 billion in 1989. (Bell-Boeing Point Paper, 1990, p. 1) Considering these

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[4] Interestingly, Bell and Boeing, partners in V-22 development, place different emphasis on the airplane's dual-use potential. Bell extols the virtues of immediate technology transfer. Boeing's conservative approach emphasizes the application of the tiltrotor process to the commercial sector. (Phoncon Industry Analyst, 1991)

facts, the political appeal of this industry becomes understandable.

The following observations characterize congressional involvement with dual-use technology in general, and the V-22 in particular:

> The Japanese Minister of International Trade, after visiting the Bell plant manufacturing the V-22 in Fort Worth, Texas was reported to have commented, "If you produce this aircraft we will buy it, if you do not, I guarantee you we will build it." (Bell-Boeing TT-1, 1990, p. 1)
>
> "I'm for the V-22 for several reasons. Number one, I think it does represent the kind of modernization and capacity that we need to be able to carry out the missions that we're going to be called upon in the decade of the '90s and in the 21st century to perform."
>
> "Secondly, I am very concerned about the technology it embodies because I really believe that, with military production and use, that we can develop an aircraft for commercial use that can be a godsend to us in terms of commercial transportation." Senator Phil Gramm (Jacovis, 1990, p. 8)
>
> "...At some point, when our principal suppliers [of oil] in the Middle East are threatened by a neighbor, I think that you're going to see the United States defend our oil supplies there...and I think it will come within the lifetime of an Osprey. I don't mind telling you that in the back of my mind, I think about that, and I will think about that as we deliberate and mark this bill up and decide what we're going to do about the Osprey."[5] Senator Dale Bumpers (Jacovis, 1990, p. 8)

Congressional concern over foreign encroachment into the aerospace industry may be validated. The European share of rotorcraft manufacturing for the international market has risen from "just a few percent in the 1950's to more than 50

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[5] Senator Bumpers made these comments prior to operation Desert Storm/Shield.

percent today" (Bell-Boeing Point Paper, 1990, p. 1). A European consortium of five government-owned companies (EUROFAR) organized to field a civil airplane incorporating tiltrotor technology. (Bell-Boeing Point Paper, 1990, pp. 1-2) Also, during this decade, Japanese-owned Ishida Corporation will build two prototype tiltwing airplanes at a plant constructed in the "backyard" of Bell's Fort Worth facility (Bell-Boeing TT-1, 1990, p. 1).

For the reader with a quantitative orientation, consider the following:

> During this decade, the number of air passengers will increase by 74% and the number of jet transports will increase 32%, without the increase in infrastructure support.
>
> Only three runways are expected to be added to the nation's ten busiest airports while their operations increase 21%.
>
> Fifty million hours of lost time to the traveling public is expected to double in the next decade. (Bell-Boeing TR-1, 1990, p. 1)

Most congressional support for the V-22 program comes from congressmen advocating tiltrotor technology as opposed to its strict military application (Phoncon Industry Analyst, 1991). The programmatic and financial implications of congressional support, while indirect, have been profound. For reasons expanded upon in the next chapter, the V-22 program has survived testing delays and budget cuts because of the promised spillover economic benefits, for the safety of

domestic airspace, and for United States national security (Phoncon Boeing PAO Officer, 1991).

G. FEDERAL AVIATION ADMINISTRATION (FAA) INVOLVEMENT[6]

For a myriad of reasons (e.g., airport congestion, safety, and economic vitality), the FAA finds itself at the center of developing commercial tiltrotor (CTR) policies and procedures. As noted earlier by Jim McDaniel, FAA officials view with enthusiasm the enormous civil potential represented by the V-22. The following benefits for civil aviation are argued:

> Tiltrotors improve runway efficiency. 56% of the departures carry 82% of the passengers on trips greater than 300 miles. 44% of the departures carry 18% of the passengers on trips less than 300 miles. Tiltrotors would free-up this runway space, i.e., increased efficiency/safety for long-duration flights. (Norwine, March/April 1990, pp. 55-57)

> Whereas $4-6 billion is required to build one airport (assuming site availability), it would cost far less for a <u>total</u> tiltrotor system, including aircraft development and production together with 18 vertiports. (Norwine, March/April 1990, pp. 55-57)

Developers of commercial tiltrotor airplanes read FAA commitment toward civilian certification as a litmus test of their future development effort (Fisher, 1991, p.2). The establishment of a Civil Tiltrotor Program Office under the FAA, a memorandum of agreement (MOA) between the FAA and the

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[6] The FAA will develop policy and certification requirements for commercial tiltrotor (CTR) application. However, the National Aeronautics and Space Administration (NASA) actively contributes to advancing CTR technology. Too, credit the Port Authority of New York/New Jersey for their involvement researching the tiltrotor infrastructure at the metropolitan level.

Department of Defense to allow concurrent testing, and the FAA-sponsored Port Authority of New York/New Jersey Study encourage continued tiltrotor research by our national aerospace industries. Still, the commercial tiltrotor industry cannot carry the entire burden of tiltrotor development:

> "For the tiltrotor to reach its full potential and place in aviation history, the FAA has to lead in the development and fielding of a safe and efficient system of vertiports...There is no private business or manufacturer who can legally lead in this effort." (Fisher, 1991, p. 5)

The financial implications, albeit indirect, if the V-22 becomes part of the military inventory are considerable. "FAA certification of the tiltrotor without a military version is estimated to cost $1.3 billion, nearly four times more than the $350 million that would be required given Defense Department procurement of the aircraft" (Bell-Boeing MV-1, 1990, p. 1). Civilian requests for tiltrotor airplanes in the 40 seat range exceed 2,600 individual units (NASA Phase II Final Report, 1991, p. 26). It is argued that the large number of potential foreign sales translates to an economic benefit of between $10-15 billion by the year 2010 (Bell-Boeing U-1, 1990, p. 2).

H. CLOSING COMMENTS

The purpose of this chapter is to provide information on the national economic benefit of V-22 development due to

dual-use application. The skeptic may postulate that if the V-22 represents such promising technology for civil aviation, commercial interests should fund and develop it independent of DoD. The answer is that, "Commercial customers simply cannot and will not take the enormous financial and operational risks of an unproven new aircraft: they want enough operational experience to verify safety, reliability, and operational costs and characteristics" (Bell-Boeing MV-1, 1990, p. 1). Also, commercial industry awaits the results of operational testing of military airplanes to establish market credibility (Bell-Boeing MV-1, 1990, p. 1). A military airplane first is not without precedent, e.g., the Bell 204 through 214 series commercial helicopters and the Boeing 707 commercial jet (Bell-Boeing COM-1, 1990, p. 1). Clearly, industry and others believe a civil tiltrotor built by domestic firms requires government subsidization to some degree. It is difficult to see how it could be funded independent of DoD input.

Many reasons are advanced for continuing V-22 development, i.e., a military version first:

- The federal government has expended $2.2 billion in V-22 development. Private investment exceeds $200 million. (Bell-Boeing TT-1, 1990, p. 1)
- The first airplane will cost a fortune. It takes quantity of production to take advantage of a learning curve effect. Because the military will procure in excess of 600 airplanes, the expected cost to commercial airlines will become acceptable. (Phoncon Bell-Boeing Marketing Director, 1991)
- Over 30 cost/benefit studies (both military and commercial) on the V-22 have unequivocally found the

airplane to be more capable and efficient per dollar than conventional helicopter alternatives (Phoncon Bell-Boeing Marketing Director, 1991). Notable cost/benefit studies include those sponsored or conducted by NASA, IDA, Lawrence Livermore National Laboratory (LLNL), and the New York/New Jersey Port Authority.

Europe's EUROFAR, Japan's Ishida Corporation, and the Soviet Union's Mil Design Bureau are government subsidized, i.e., nationalized ventures in a race to develop and market a tiltrotor airplane. According to Crawford Brubaker, former Assistant Secretary of Commerce, "whoever captures the tiltrotor market can anticipate at least $500 million per year in sales in the next decade" (Brubaker, 1990, p. 77). Unlike their American counterparts, foreign industry is not dominated by the need for an immediate return on investment (ROI) (Phoncon Bell-Boeing Marketing Director, 1991). Producing tiltrotor airplanes is such a high risk yet financially lucrative investment that foreign governments are willing to subsidize continued development.

To summarize, dual-use technology may provide a useful systems acquisition justification for the United States government, but it must be tailored to the subject program, i.e., to avoid the "template" mentality. Barriers to effective integration of the defense and commercial sectors will continue given current regulations and other factors. The V-22 is a robust example of dual-use technology that may be argued is needed to enhance our economic competitiveness and national security.

IV. BUDGET HISTORY OF THE V-22

A. PURPOSE OF CHAPTER

The V-22 is no stranger to controversy. In fact, one newspaper columnist appropriately likened the scrutiny of the V-22 to a blistering by the sun. He went on to state:

> Indeed, no defense program in recent years has been more challenged, scrutinized, abused, evaluated, debated, abused, analyzed, cost-benefitized, test flown, prototyped, and then abused again. There's been, in fact, so much sunlight, the program seems blistered by it. (Harvey, 1991, p. 46)

The intent of this chapter is to provide insight to the decisions made by the "players" involved with the V-22 program. To that end, the final two chapters of this thesis address the following questions: First, what does the V-22 teach us with respect to defense budgeting? Second, what are/were the roles and relationships between the military departments, the Department of Defense, contractors, and the Congress in budgeting for the V-22? Finally, what are the program the political competition between the Secretary of Defense, Congress, and other interested parties in financial terms, and in terms of the future of the V-22? Answers to these questions are provided, in part, by a review of congressional action on the V-22 program.

B. BUDGET EVENTS 1982 - 1988

Chapter II and Appendix (A) provide a chronological history of the V-22 program and the evolution of tiltrotor technology. In FY-82, the JVX program received initial funding from Congress to begin development. During the subsequent years, program funding increased incrementally as preliminary design graduated to full scale development. From the period beginning in FY-82 and continuing through FY-88, Congress appropriated approximately $1.824 billion for the V-22 program. Appendix (B) gives the reader a comprehensive matrix of congressional action taken on the V-22. Through 1987 the V-22 program experienced "normal" congressional action; however, other significant events would ultimately impact the V-22 program.

1. The utility of joint procurement programs

On the surface, joint procurement programs seem advantageous. The Department of Defense may realize substantial savings by procurement of a major system suitable to mission requirements of more than one service branch by exploiting economies of scale. The benefits received through mass production may offset the limits of funding allotted to each service.

This must be tempered, however, by resisting attempts to force a service to except a weapon they don't want. The High Mobility Multi-purpose Wheeled Vehicle (HMMWV) provides

a good example of such a pitfall. Both the Army and the Marine Corps purchased HMMWV's. However, the Marines CH-46 is not configured to carry the HMMWV internally or externally. This leaves the Marine CH-53E as the only helicopter capable of transporting a HMMWV. (Phoncon CBO Analyst, 1991)

From the beginning, the V-22 was designed and promoted as a joint airplane. With minor modification, the airplane would satisfy the Joint Services Operational Requirement (JSOR) of the three participating military services. Its utility for broad application, increased capability, and promotion of advanced aerospace technology underlined the theme of this period. (Bell-Boeing Press Release TVA-1, 1990)

The reality of joint programs provides an ironic twist to this situation. As resources, particularly in the Program Objective Memorandum (POM) years, became more restricted, the military services' become increasingly selective. As the time drew closer to "pay the bill," the scrutiny of individual programs seemed to grow exponentially. This is exactly what occurred with the V-22 when the Army withdrew from the program in the Spring of 1983. (Phoncon Bell-Boeing Business Development Manager, 1991)

2. The Army withdrawal

There are at least two reasons why the Army cancelled their JVX requirement. The first centers on the decision to make the Light Helicopter Experiment (LHX) their number one

aircraft priority. The Army could not afford both the LHX and the V-22. With the CH-47 (Chinook) in inventory, their heavy-lift requirement could be met in the future. (Phoncon Bell-Boeing PAO Officer, 1991) Further, the Army felt it important to show unanimity for one system in view of the mood of Congress and a declining defense department budget (Phoncon Bell-Boeing Supervisor Naval Requirements and Marketing Director, 1991).

The second reason might appropriately be called "board-room" tactics. The Army had sacrificed other programs to retain the LHX (Phoncon Bell-Boeing PAO Officer, 1991). They knew the Marine Corps, out of necessity to replace the CH-46, would continue to lobby hard for the V-22 (Phoncon Bell-Boeing PAO Officer, 1991). At some future date, the Army felt it could reenter the V-22 program and ultimately end up with both airplanes.

Whatever the reason, the Army's decision produced a major impact on the V-22 program. When the Army cancelled, it eliminated the requirement for 231 aircraft. As expected, the unit cost of the remaining airplanes ordered escalated dramatically. So profound was the effect of this decision that when the Secretary of Defense later testified to the House Armed Services Committee on his rationale for cancellation of the V-22 program, he stated that if "the Army were seriously interested in the V-22, that would help significantly in ... reducing the unit cost of the system and

justifying the investment that would be required" (Cooper, 1991, p. 3).

3. Political events relevant to cancellation of the V-22

From a military perspective, the Reagan administration's attitude toward defense spending was a welcomed relief compared to the relatively austere times associated with the previous administration. President Reagan's Secretary of Defense, Caspar Weinberger, was extremely supportive of most major weapons systems. Perhaps this support bordered on the extreme in that he eventually lost credibility with, and patience of, Congress. (Lopez, 1989, p. 4)

The Department of Defense budget attained its post WWII peacetime apex during FY-85. Following this, a series of events created a declining defense budget. First was the escalation of the federal deficit. In the face of unprecedented peacetime deficits, the Administration continued requesting growth for the defense department - severely testing the patience of Congress. Second, in October of 1987 the stock market crash effectively turned the public's attention back to fiscal reality. Finally, in 1989, the first of two Bipartisan Budget Summit Agreements signaled a formal shift in national policy. Before departing office, President Reagan submitted a budget to Congress with two percent real growth for defense. (Lopez, 1989, p. 3)

When President Bush came into office he sought to appease Congress by proposing a one year freeze on defense spending. This meant that the Pentagon would be forced to reduce its original FY-90 request by six billion dollars. (Lopez, 1989, p. 3)

President Bush also had difficulty receiving approval for his nomination of John Tower to the position of Secretary of Defense. The bitter and protracted Tower nomination debate resulted in the vacancy of the chief executive position at the Pentagon for nearly four months. Representative Richard Cheney became the Secretary of Defense in April of 1989. He encountered two problems requiring immediate attention. First, the President had committed the Pentagon to budget reduction, compounded by the second summit agreement, resulting in a net budget reduction at the Department of Defense of ten billion dollars for FY-90.

The second hurdle addressed the quality of leadership. Secretary Cheney was the second choice of the President. It became imperative to the Administration's success that Secretary Cheney establish firm control of the Department of Defense. (Lopez, 1989, pp. 3-4)

For reasons to be discussed in a subsequent portion of this chapter, Secretary Cheney opted to cancel the V-22 program. Because cutting at the margins is less effective than cancellation of "big ticket" programs, the V-22's sizable budget was too tempting to resist. Also, Secretary Cheney

received advice from his staff that the V-22 was not cost-effective.

C. V-22 BUDGET EVENTS OF FY-89

The remaining fiscal years, 1989 through 1992, will be analyzed by fiscal year, according to congressional action taking place during the particular period.

1. Congressional action

Fiscal Year 1989 resulted in the largest amount of R&D funds appropriated for the V-22 program, at $667 million. In addition, both the House Armed Services Committee and the Senate Armed Services Committee authorized $355 million for procurement of twelve pilot production airplanes[1]. The Senate Armed Services Committee Authorization Act referenced a potential decision by the Navy to delay the V-22 for a year. The Committee directed that if the Secretary of Defense supported such a decision by the Navy, authorized V-22 procurement funding could only be transferred to other Marine Corps procurement. (SASC Report No. 100-326, 1988, p. 29)

The appropriation committees concurred with the authorization language, but the House Appropriations Committee Bill evidenced additional congressional concern over the V-22:

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[1] Pilot production planes are essentially the planes the services will take delivery on with minimal modification. The acquisition strategy called for eight planes to be built jointly by Bell and Boeing. Each company would then build two planes independently. The government would subsequently award a contract for future lots to the lowest bidder. (Phoncon Bell-Boeing PAO Officer, 1991)

> As the program evolved over the past few years, many changes have taken place. The Committee believes that this gives cause to reevaluate all aspects of the V-22 procurement strategy, including annual procurement rates and the decision to tool-up both contractors to give them the capability of building the entire V-22 aircraft. (HAC Report No. 100-681, 1988, pp. 96-97)

The report defined certain actions Congress "expected" to be undertaken by the Department of Defense, i.e., submitting a revised acquisition strategy and the request for six V-22's (minimum) in the administration's FY-90 budget. This language signals a detectable increase in Congress' attempt at management of the V-22 program. Comprehensive figures on congressional action taken in FY-89 may be found in Appendix (B).

D. V-22 BUDGET EVENTS OF FY-90

This section will address the decision by Secretary Cheney to cancel the V-22, the effects of this decision, and congressional action taken in response.

1. The decision to cancel the V-22

In April of 1989, the Secretary of Defense recommended canceling the V-22 program and provided as an alternative a mixture of upgraded conventional helicopters to reassure both the Navy and Marine Corps (Simmons et al., 1990, p. 1). Secretary Cheney proposed procurement of 703 CH-60's (Blackhawk) and CH-53E's (Sea Stallion). His testimony concluded that this action alone would save the Department of

Defense seven billion dollars in the POM (Jacovis, 1990, p. 1).

Reaction from advocates of the V-22 program over the decision to cancel was immediate. Frustrated by the timing and secrecy of the cancellation decision, supporters of the V-22 program in Congress criticized the "incompleteness" of the PA&E analysis. V-22 proponents claimed this price and configuration analysis didn't consider life-cycle cost, or design features built into the V-22 to enhance the efficiency, survivability, and reliability over the CH-60/CH-53E mixture. (Center for Strategic Policy Report No. 90-16, 1990, p. 3) On why the V-22 program was cancelled, a report published by the Center for Security Policy commented: "...the answer lies in the convergence of budgetary pressures on the one hand and, on the other, the over-reliance of a new Secretary of Defense on the advice of key subordinates with a penchant for shortsighted, penny-wise and pound-foolish approaches to managing defense programs and operations" (Center for Strategic Policy Report No. 90-16, 1990, p. 2).

The military chiefs of the Army, Navy, and Marine Corps lobbied hard in their limited time before Secretary Cheney to continue V-22 development. Alternatives to the Secretary's proposal were prepared; however, it is unclear whether the Secretary of Defense ever formally considered them. (Phoncon Bell-Boeing JPO, 1991) In fact, the Marines identified specific offsets (e.g., the PA&E helicopter

alternative and the M-1 tank) in addition to a proposal by the contractors to restructure the V-22 program to reduce up-front cost (Center for Strategic Policy Report No. 90-16, 1990, p. 4). However, the Secretary of Defense remained adamant.

Some proponents of the V-22 program advance the opinion that Secretary Cheney's decision was purely political and stemmed from a disagreement between the Secretary and House Representative Jim Wright (Phoncon Bell-Boeing JPO, 1991). This opinion should not come as a surprise, because generic to any major systems acquisition are the customary "pork" and "turf" considerations. Therefore, the reason for the cancellation decision may never be known. But it is evident that Secretary Cheney and some members of Congress were and still are at odds over national strategy and the military hardware required to counter the threat on future battlefields.

a. The effects of cancellation

Assuming the V-22 enters production at some point, total program costs have increased from an estimated $22.3 billion, when the program was deleted, to $25.4 billion (Ferber, 1991, pp. 3-4)[2]. Developmental problems, testing schedule slippages, advancing technology (e.g., software modifications), contract modifications, inflation, and

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[2] Both figures are in 1990 dollars to procure 657 airplanes. Refer to Chapter II, TABLE II.

uncertainty by the contractors to receive V-22 production funding caused them to slow their efforts. These factors have resulted in a FSD contract that is at least two years behind the original Milestone IIIA (pilot production) decision point of December 1989 (Ferber, 1991, p. 7).

Further, "...when DOD terminated long-lead procurement, Bell/Boeing retained funds to cover termination costs - currently $78 million" (Ferber, 1991, pp. 6-7). The original FP contract required the contractor to pay $600 million for tooling costs and for DoD to pay $300 million. When the contract was terminated the Navy had to waive this clause. Finally, cancellation of procurement contracts voided the "not to exceed" options (NTE's), effectively eliminating any guarantee on a fixed unit cost. (Phoncon Bell-Boeing Business Development Manager, 1991) Again, assuming the V-22 enters production at some point, the options and clauses noted above will have to be renegotiated - obviously a more expensive undertaking compared to the original FP contract.

At the time of cancellation, the V-22 was projected to cost approximately $28 million (FY-90 dollars) per airplane. The unit cost for the airplane is now approximately $45 million for the following three reasons. First, delays in the program have shifted production three years to the right. A principle effect on cost was inflation. Second, the annual production rate is expected to top out at between 60 - 72 airplanes per year once production is at full scale. This

results in a additional six years of production. Third is the reduced ramp-up, i.e., advantages gained from learning curve effects are lost. (Phoncon Bell-Boeing Business Development Manager, 1991) Thus there are arguments for a more thorough review of the cancellation decision.

Yet the non-quantitative effects of the V-22 provide the most interesting insight. For reasons to be explained in detail in the remainder of this chapter, the interaction of the human element - Congress, the military departments, contractors, and the Department of Defense - influences conclusions on the V-22 budget. What becomes obvious is that even technically sound, efficient, and promising weapon system programs are not guaranteed for approval. The progress and success of a program are driven by the human element reacting to the current political and budgetary climate.

2. Congressional reaction to the cancellation decision

Fiscal Year 1990 proved an extremely busy period for congressional action on the V-22 program, in particular for advocates of the program. What ultimately became the Tiltrotor Coalition in Congress began taking form as bipartisan alliances, with their foundation in the pork barrel based on technological advances represented by the V-22. The coalition organized to obtain continued funding for the V-22 production despite the decision by the Secretary of Defense to

cancel it. Coalition proponents emphasized modernization of conventional vice strategic forces. For his part, the Secretary of Defense remained staunchly opposed to the program, as reflected by the absence of a request for V-22 funding in the DoD budget. However, while Congress was not willing to support procurement, it became unequivocally committed to continued development.

In its FY-90 bill and report, the House Armed Services Committee authorized $351 million for R&D and $157 million to preserve options for procurement of 12 pilot production airplanes. Also, the Committee reduced the administration's request to buy additional CH-53E's by $157 million. Interestingly, House Armed Services Committee Chairmen Representative Les Aspin supported Secretary Cheney's cancellation decision. Chairman Aspin lost considerable support because of this decision and the following year he reversed his opinion, citing advances to be gained for the aerospace industry and the results of the IDA study. (Towell, September 1990, p. 2782)

A concerned House Armed Services Committee directed the Secretary of Defense

> "to provide with the FY1991 budget request an independent cost and operational effectiveness analysis of all reasonable V-22 alternatives including but not limited to, the CH-53E, BV-360, EH-101, CH-46E,CH-60 aircraft or any combination thereof." Noting that the program was 8 months behind schedule and had experienced procurement cost growth, the committee reasoned that "program termination is not warranted" because "the magnitude of the delay and the technical problems are not unusual in

> such a program," and the cost growth "results from the cancellation by the Army of its purchase of the aircraft and the Navy stretch out of its purchase of aircraft." (Cooper, 1991, p. 4)

The other defense committees, by reference to this language, supported the necessity for the study and tied future funding to results of the analysis.

The Senate Armed Services Committee noted Secretary Cheney's concern for a large price tag for the V-22's "narrow" missions; however, the Committee itself was concerned with broader implications (i.e., the impact to civil aviation, the potential for export, and the two billion dollars already invested). The Committee authorized $255 million for R&D, along with a sense-of-Congress amendment "urging" the President to continue the V-22 program. (SASC Report No. 101-81, 1989, pp. 46-48)

The Senate Armed Services Committee did not authorize procurement funding. Nevertheless, they directed the Secretary of Defense to address four questions to be resolved before procurement. The first of these concerned the potential tiltrotor technology for civil aviation. Second, the contractors were "challenged" to support their claims of potential of civil application by providing concrete evidence of interest. Third, the Secretary of Defense and the Federal Aviation Administration (FAA) were asked to appraise export potential, including steps the Department of Defense and other government agencies would take to foster the commercial

potential in international markets. Finally, the Secretary of Defense was asked to examine "innovative alternative arrangements" for production of the V-22 and to suggest introducing Total Quality Management (TQM) into the program. (SASC Report No. 101-81, 1989, pp. 46-48)

The Senate Armed Services Committee concluded by directing the military department secretaries to reevaluate the V-22 potential. The Committee became interested in the application of amphibious operations and directed the Joint Chief of Staff to "coordinate an examination of the roles and missions of all amphibious forces and the special operations missions." (SASC Report No. 101-81, 1989, p. 48)

The conference on the authorization bills concurred with the amount authorized by the Senate Armed Services Committee. Comments were limited, centering mainly on the potential military and civilian application of the V-22, but they also noted that the cost of the program "may prove unaffordable." (Cooper, 1991, p. 5)

The House Appropriations Committee appropriated $351 million for R&D and $157 million for long-lead procurement. The Senate Appropriations Committee appropriated $255 million for continued development but no funding to gear up for production. Also, both the Senate Appropriations Committee and the Senate Armed Services Committee rejected $157 million for procurement of CH-53E airplanes.

Like the other defense committees, conferees for appropriations recognized the commercial potential of the V-22 and understood that commercial application was not likely without military development first. The conference committee "...expressed 'keen regret' that the program is jeopardized at a time when our military planning must be tailored to account for change in the strategic environment." (House Report No. 101-345, 1989, pp. 72-73)

The conference committee for appropriations argued that the results of the IDA study should be used to base future decisions as to whether to begin production in FY-91. The Committee also stressed the importance of obligating FY-89 long-lead procurement dollars to preserve production options. Finally, like the other defense committees, the appropriation conference provided the Secretary of Defense with a list of questions on the V-22 to be analyzed, and directed his department to report back within six months.

Review of the V-22 program by Congress became increasingly frequent and detailed. Congress, still agitated by the Secretary of Defense's decision to cancel the V-22 program, provided increasingly restrictive language with respect to the V-22 program (Phoncon OLA Military Representative, 1991). Further, as usual Congress was compelled to question the military equipment and strategy postulated by the Department of Defense. The V-22, a long-term, major systems acquisition program, became progressively

subjected to short-term resource decisions resulting from budget cuts and a Congress interested in minute details. Comprehensive figures on congressional action taken in FY-90 are found in Appendix (B).

E. V-22 BUDGET EVENTS OF FY-91

This section addresses continued resistance by the Department of Defense to obligating funds previously appropriated by Congress. Decisions rendered by the General Accounting Office and the United States Comptroller General on the propriety of this deferral, and the effect of the FY-91 Dire Emergency Supplemental Bill are examined. Finally, congressional action taken in FY-91 on the V-22 is summarized.

1. Department of Defense involvement

The Department of Defense FY-91 budget request proposed taking approximately $1.4 billion in FY-90 defense programs and spending it on other programs DoD considered more important (Fessler, 1990, p. 335). The request contained no new funding for the V-22 program. The Department of Defense Comptroller stated, "we ain't going to spend the money" for the purposes intended by Congress (Fessler, 1990, p. 335).

The proposed deferrals and transfers involved programs some members of Congress felt strongly about. Congress perceived this to be an attempt by the Administration to control the purse strings - long the exclusive domain of Congress. Said one Senate Appropriations Committee staffer,

"if they can get away with it, it's tantamount to a line-item veto." (Fessler, 1990, p. 335)

After the decision to cancel the V-22 program, the Department of Defense Comptroller withheld $200 million in FY-89 procurement funding previously appropriated by Congress. Three events effectively forced the Secretary of Defense to release these funds to the Naval Air Systems Command. First, a General Accounting Office review concluded that the Department of Defense deferral was unauthorized because:

> ...the conferees on FY1990 authorizations had permitted the obligation of FY1989 procurement funds by rejecting Senate language to prohibit the use of prior-year procurement funds. The Impoundment Control Act, in GAO's view, does not authorize the Administration to substitute its policy choices for those of Congress on grounds of establishing "a contingency against incurring additional unnecessary costs," as DOD justified its de-obligation action. (Cooper, 1991, p. 5)

Second, the Senate Appropriations Committee, in its FY-91 report, cited a decision by the Comptroller General of the United States that the Department of Defense decision to impound FY-89 advanced procurement was unauthorized. The Committee noted, "...that the decision of the DOD to impound the fiscal year 1989 funds has had an adverse impact on the program's production schedule and overall cost." (SAC Report No. 101-521, 1990, p. 195)

Finally, a rider tacked on to the FY-91 Dire Emergency Supplemental Bill directed the Department of Defense to obligate the $200 million of FY-89 funds within 60 days or by May 9, 1991 (Ferber, 1991, p. 6). The Department of Defense

Comptroller subsequently complied with provisions in this bill, indicating that the money would be used to fix weight related problems on the V-22.

To synopsize the notable events occurring in FY-91, it appears the V-22 became less a programmatic issue, i.e., a program that Congress chose to support based only on the plane's advanced aviation capability. The V-22 program became the locus of a battle over the separation of power between the executive and legislative branches. The disagreement between the Secretary of Defense and Congress abated only after intervention by external agencies and passage of a Supplemental Bill. Even now, contempt, skepticism, and tension remain high. Both sides seemed poised for additional conflict. However, language in FY-92 congressional reports seems to provide a "politically" appealing solution for both sides.

2. Congressional action

It is useful to set the stage with respect to the mood of Congress before expanding on specific congressional action in FY-91. In 1989, Representative Les Aspin, Chairman of the House Armed Services Committee, and Senator Sam Nunn, Chairman of the Senate Armed Services Committee, had previously provided the Administration, via Secretary Cheney and General Colin Powell, stern advice on Congress' view of the military strategy for the future. They criticized the FY-90 defense

budget as undynamic, consisting of cosmetic changes, and, above all, oblivious to the political transformation occurring throughout the Soviet bloc. Congress expected the Administration to return the following year (FY-91) with a more realistic strategy for the future threat.

For FY-91, the House Armed Services Committee authorized $238 million for R&D for the V-22, $165 million in new procurement, and $200 million in deferred FY-89 procurement funds. They directed that the $365 million for procurement be applied to support a V-22 pilot production option in FY-92. The rationale cited by the Committee included the large sunk cost, flight test results, and "generally" favorable results of the IDA study. A skeptical Committee made the following comment in support of the new funding for R&D: "...the Department of Defense has chosen to ignore Congress' directives in the development of this aircraft and has chosen, instead, other programs that do not appear to consider the changing world environment...." (HASC Report No. 101-665, 1990, p. 160)

For its part, the Senate Armed Services Committee took a passive approach toward immediate production of the V-22, opting instead for continued testing. The Committee noted the waning maintainability and safety of the CH-46; however, it refrained from authorizing additional procurement funding for the V-22, citing concern for problems with weight, vibration, and compatibility. Additionally, the Committee members viewed

V-22 production at this point to be "premature" and to violate the principle of "fly before buy."[3] (SASC Report No. 101-384, 1990, p. 73)

The Senate Armed Services Committee's final report authorized a total of $238 million, including $200 million in FY-89 funds and $38 million in new funds. The Committee recommended that these funds be transferred to R&D to "...reduce the uncertainties associated with developing and producing this innovative aircraft" (Cooper, 1991, p. 6). Finally, the Committee addressed the "crusade" by Secretary Cheney to kill the V-22 program and, indirectly, noted its annoyance with his alternative by dramatically reducing funding for CH-53E helicopters[4]. (Towell, July 1990, pp. 2430-2431)

The Conference Committee authorized $238 million for continued R&D but expressly prohibited use of these funds for R&D of "alternative" airplanes (House Report No. 101-923, 1990, p. 27). The Committee authorized $165 million from Navy procurement to be combined with the $200 million (R&D) in FY-89 funds for advanced procurement of "production

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[3] "Fly before buy" is a nebulous definition, often subjected to politics and double standards. Technically it indicates completion of initial operational testing prior to production. (Phoncon Bell-Boeing Business Manager, 1991) Developmental models already have logged more than 500 flying hours, meeting the Pentagon's standard for "fly before buy" (Scarborough, 1991, p. 4).

[4] The Senate Armed Services Committee authorized procurement of CH-53E's in support of Naval Reserve requirements only.

representative" airplanes, and support equipment to continue operational testing (House Report No. 101-923, 1990, p. 23).

The House Appropriations Committee echoed the amounts authorized by the House Armed Services Committee. However, language contained in the House Appropriations Committee report reflected the Committee's frustration with perceived procrastination by the Department of Defense. For example, the Committee "expected" the Department of Defense to release FY-89 funds immediately and the Committee "expected" the Navy to enter contracts "expeditiously" to support procurement of four airplanes in FY-92. (HAC Report No. 101-822, 1990, p. 126)

The Senate Appropriations Committee agreed in principle with the amounts authorized by the Senate Armed Services Committee. Senate Appropriations Committee language explicitly addressed the disposition of the CH-53E alternative, stating that, "the funding was not required with the continuation of the V-22 program" (Senate Report No. 101-521, 1990, p. 195). The House and Senate appropriation conferees agreed to appropriate the amount authorized in conference, but added an additional $15 million for Air Force, Special Operation Forces (SOF) development.

Issues present throughout debate in this fiscal year, and conspicuous in all Committee reports, included the necessity to capitalize on the V-22's civil potential, and the cavalier attitude toward Congress expressed by senior

executives within the Department of Defense. Nevertheless, the funding instability created by this situation only aggravates long-term production plans from the view of V-22 supporters. Comprehensive figures on congressional action taken in FY-91 may be found in Appendix (B).

F. V-22 BUDGET EVENTS OF FY-92

By most accounts, FY-92 will be the crucial decision year for the V-22 program. Indirectly, the fate of this program could rest in decisions made by Congress on the B-2 Bomber and the Strategic Defense Initiative (SDI) - both expensive programs with supporters in Congress and the Department of Defense. Language in the FY-92 Committee reports contains ample posturing, allowing room for the expected compromise in conference.

The House Armed Services Committee report offers the most optimism for V-22 proponents. This bill, if approved in conference, funds three additional "production-like" airplanes[5] in FY-92, and provides both Congress and Secretary Cheney with the politically appealing position of not having to approve actual production. Also, language in the House

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[5] In the case of V-22, "production-like" aircraft, with minimal modification, will be the same aircraft the Marine Corps takes delivery on. In accordance with recently updated Department of Defense acquisition instructions, the V-22 must complete a full scale engineering and manufacturing development phase ; hence, the terminology of production-like aircraft built with production-like tooling. Language in congressional reports is simply agreeing with the new instructions.

Armed Services Committee report will shift the cost of six production airplanes to R&D. This action dramatically reduces the apparent unit cost of a V-22 airplane - particularly important as the cost-per-unit had become prohibitive (Phoncon Industry Analyst, 1991).

Informal indicators, i.e., unofficial opinions by military and industry personnel assigned to the V-22 program, point to sufficient funding for the V-22 in FY-92 (Phoncon Bell-Boeing JPO, 1991). However, the rhetoric from members of the House Armed Services Committee is far from conciliatory. Accusations of "deliberate stalling" and "defying congressional mandate" are not uncommon (Koszczuk, 1991, p. F-1). Representative George Darden commented:

> "You're playing games, and I don't see how you can sit there with a straight face...If you wanted this thing it would have flown all over Desert Storm. What we've got here is deliberate stalling on a project that Congress wants" (Koszczuk, 1991, p. F-1).

Representative George Hochbrueckner warned the Department of Defense that, "...if building the V-22 becomes a test of wills with the Bush administration, Congress will prevail" (Koszczuk, 1991, p. F-1). He went on to say:

> "This plane is going to happen. If it's a little overweight, if it's 4 knots too slow, who cares? We need it. We're going to do it, with or without the administration" (Koszczuk, 1991, p. F-1).

With this information as background, congressional action is provided in the next section.

1. Congressional action

The Department of Defense again requested zero new funding for the V-22 in 1991, opting instead for a general provision that would merge FY-91 production funds and R&D funds into continued development (HASC Report No. 102-60, p. 145). The House Armed Services Committee report indicated some misgivings with the proposal, stating:

> The committee is concerned that the department's plan for continuation of the V-22 aircraft development resolve the technical and performance issue and confirm the producibility of the V-22. The committee believes the V-22 aircraft development program should be restructured to make use of the experience gained to date in development and testing of the V-22 aircraft, resolve and demonstrate technical issues...The committee believes further that the aircraft used for these operational tests should be manufactured on hard or production-like tooling to validate the production process. (HASC Report No. 102-60, 1991, p. 145)

Before actual production, the Committee wanted airplanes to be built under simulated production conditions, and under the Full Scale Development (FSD) umbrella. They view this direction as a "prudent and fiscally responsible approach to validation of the manufacturing process and confirmation of the operational suitability of the V-22 aircraft" (HASC Report No. 102-60, 1991, p. 145).

The House Armed Services Committee recommended a total authorization of $990 million in funding for FY-92 to support production of three airplanes, and $755 million in FY-93 for

another three airplanes[6]. The FY-92 authorization provides $625 million in new R&D funding and recommends transferring $365 million in prior year funds to R&D.

The Senate Armed Services Committee noted some significant aspects of justification for the V-22 program, highlighting the need to replace the Marines CH-46 "immediately," and its concern over the crash of V-22 airplane number five on June 11, 1991[7]. The Committee also commented on the V-22's technical uncertainty, noting that the airplane requires continued development before production. Accordingly, the Senate Armed Services Committee authorized zero new funding, and directed $365 million of prior year funds for continued development. (SASC Report No. 102-113, 1991, pp. 115-116)

Referencing the IDA study that recommended procurement of 356 V-22's, the Committee noted the potential for a reduced requirement for deck space aboard amphibious ships. On the premise that less amphibious shipping would be an indirect effect, the Committee directed the Secretary of Defense to report to the defense committees on the feasibility of

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[6] A revised contract for production-like aircraft calls for a buy of 3-3-4 beginning in 1992 (Phoncon Bell-Boeing Business Manager, 1991). The new contract will be cost-plus because the Navy lost the option for a fixed price airplane when the Secretary of Defense ordered the program canceled.

[7] On Tuesday, June 11, 1991, at approximately 6:08 p.m., V-22 flight development Aircraft #5 crashed while undergoing its first flight at the Boeing Helicopter Flight Test Center in Wilmington, Delaware (Bell-Boeing ACFT 5-1, 1991, p. 1).

redirecting funding for procurement of shipbuilding to help defray the cost of the V-22 program. (SASC Report No. 102-113, 1991, pp. 115-116)

The House Appropriations Committee's bill paralleled the House Armed Services Committee authorization; however, the House Appropriations Committee provided specific guidance for the disposition of appropriated funds. First, the $365 million was directed to obligated by October 31, 1991, in support on a new Phase II FSD program. Second, $357 million is to be obligated by November 30, 1991, for ten production-like airplanes. Finally, the Department of Defense is directed to provide Congress the Total Funding Plan and Schedule to complete engineering and marketing development (Phase II) within 60 days after enactment of the bill. (Phoncon Bell-Boeing Business Development Manager, 1991) As evidenced by the increasingly restrictive language and detailed guidance, the House Appropriations Committee has attempted to make difficult any future program deviations by the Secretary of Defense.

The Senate Appropriations Committee appropriated no new funding for either R&D or procurement in FY-92. The Committee recommended "transfer of prior year funds to R&D ($165 million) as requested in the President's budget." (SAC Report No. 102-154, 1991, p. 142) However, the Committee approved $465 million for procurement and $50 million for R&D to "restart" CH-46E production (SAC Report No. 102-54, 1991,

p. 142, p. 267). The Committee justified its actions by noting that "...Marines may yet have the opportunity to purchase V-22 aircraft...In the meantime no progress will have been made in redressing the medium-lift shortfall" (SAC Report No. 102-54, 1991, p. 142).

The V-22, as a case example, is but one of a myriad of critical defense programs - a micro issue in the scheme of overall defense. What sets the V-22 apart from other weapon acquisition programs is the broad support within Congress. The program is, in essence, an example of Congress' ability to cross partisan lines, and its commitment to the preeminent position of the United States as the guardian of tiltrotor technology. Comprehensive figures on congressional action in FY-92 may be found in Appendix (B).

V. CONCLUSION

A. PURPOSE OF CHAPTER

This chapter addresses the three research questions presented in Chapters I and IV: What does the V-22 teach us with respect to defense budgeting? Second, what are the roles and relationships between the military departments, the Department of Defense, contractors, and the Congress in budgeting for the V-22? Finally, what are the program implications resulting from the political competition between the Secretary of Defense, Congress, and other interested parties in financial terms, and in terms of the future of the V-22? Further analysis of these roles and relationships provides some answers to these questions. The thesis will be concluded by addressing all the research questions presented in Chapter I, and some suggestions for further V-22 research.

B. ROLES AND RELATIONSHIPS IN THE BUDGET PROCESS

Either directly or indirectly, all the players (the Congress, the contractors, the Administration, and the Marine Corps) have been involved in the politics of the budgetary process. This section provides additional insight into their opinions and relationship to the V-22 program. It is proper to begin by highlighting the visibility factors that appear to have affected the program.

Everyone agrees that the V-22 program is expensive. In this period of declining financial resources, the V-22 sticks out in the defense budget like the proverbial sore thumb. Whether the V-22 is an expensive developmental program, or is justified by the payoff from the technology it advances, invokes considerable debate. Ultimately, the decision rests with our elected leaders. Unfortunately, from the Marine Corps' view, continued production postponement only serves to aggravate the realization of the V-22 as an airplane in their inventory. According to Marine Deputy Chief of Staff for Aviation, "time is probably our worst enemy right now" (Bond, 1991, p. 26).

The problems associated with development are well publicized. Every defect has been countered. For example, the General Accounting Office testimony notes cost overruns of between $200 and $242 million (Ferber, 1991, p. 3). The contractors suggest overruns are due partly to rapid advances of the technology and partly to delays with the program. The GAO advises that procurement should proceed only after resolving technical problems, i.e., weight, latency problems with the flight control system, vibration, and production of the composite material (GAO report B-240825, 1990, pp. 1-6). The program manager has flown a prototype and was satisfied with the adjustments contractors made (Koszczuk, 1991, p. F-1). Further, the contractors anticipated problems cited by

the GAO and actually plan to incorporate the changes into production by design (Ferber, 1991, p. 9).

Also, the General Accounting Office considers the V-22 program to be highly risky. Therefore, to comply with DoD instructions on defense acquisition the GAO would expect Naval contracting officers to assign a cost plus contract to the V-22 program. However, Secretary of the Navy John Lehman's decision to direct a fixed price contract due to the "maturity" of the technology effectively ended any debate on this issue.

The political aspect, as it influences those who control the purse strings, must not be overlooked. Fresh in the mind of Congress is the FSX issue[1]. Congress is concerned that we may default this technology to an overseas market. Can the crash of airplane number five remain free of political posturing, especially by those members of Congress opposed to the V-22 program? The Marine Corps, popular with Congress, continues to operate the venerable CH-46, but this cannot continue indefinitely. Finally, reduced dollars, jobs, and the broad dependance of subcontractors from 48 states, guarantees traditional pork and turf pressures in support of V-22 production.

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[1] The FSX was an advanced fighter aircraft to be built in Japan with the assistance of General Dynamics.

1. Congressional opinion

The V-22 enjoys broad support with Congress, and has encountered only minimal opposition. Some Congressmen, originally resistant to the V-22 program, have subsequently reversed their opinion in favor of development - to the point of insistence. Technical knowledge of the program by Congress runs the entire spectrum. Half the program's support is from Congressmen advocating the commercial spinoff from the military version. This factor alone distinguishes the V-22 program in that it extends beyond pork barrel politics. (Phoncon CBO Analyst, 1991)

The Tiltrotor Coalition, a grass roots lobbying organization, evolved to combat what it considers a "penny wise and pound foolish" decision by the Secretary of Defense to cancel the V-22. Its constituency includes prominent business leaders, influential members of Congress, and many civilians and contractors. Foreign competitors acknowledge that the United States is the preeminent leader of tiltrotor technology. Members of the Tiltrotor Coalition believe our nation cannot afford to import tiltrotor technology from overseas. Therefore, the coalition aggressively promotes the advantages of tiltrotor technology to the nation's aerospace industry. Their effort to involve all the subcontractors in active lobbying has proven instrumental to the resuscitation of, and continued funding for, the V-22 program.

Marines enjoy an enviable status with Congress. The Marine Corps is regarded as efficient and innovative, and considered the underdog - having to employ the "leftovers" from the other services. Rowan Scarborough, a reporter for the Washington Times observed that "The continued support of the Marine Corps - the smallest military branch with the largest congressional fan club - has been a big factor in the Osprey's winning ways" (Scarborough, 1991, p. 4). Congress seems to identify with the Marine Corps and is quick to support its military leadership. Because of the Corps' credibility, its support for the V-22 program, whether through official or unofficial channels, has not gone unnoticed by Congress. Representative Curt Weldon provided the following comments:

> "The pencil pushers in the Pentagon say they don't want the V-22. But the warriors who command the troops say they do want it. If the Marine Corps told me to back off, I'd back off. But they're not telling me to do that." (Scarborough, 1991, p. 4)

> "We've won the battle, not because of pork, but because it has solid, deep support in Congress, and in the Pentagon from the standpoint of the service leaders" (Scarborough, 1991, p. 4).

In short, members of Congress believe the Marine Corps represents a quality force and remain committed to ensuring that the necessary funding is appropriated.

Finally, the Congress, surprised by the decision to cancel the V-22 program and irritated by the obstinate position of the Secretary of Defense, has emphasized one

crucial point. Congress, by law, has the power to raise and equip military forces for national defense. Congress then, controls the purse strings, and relies on the Administration only for advice plus budget execution and management expertise.

2. Industry perspective

According to B. Dan Pinick, president of Boeing Defense and Space Group, "...aerospace companies must learn to manufacture major systems economically at low rates" (Bond, 1991, p. 26). Contractors realize that dealing with the government involves certain inherent risk. Most contractors seek to break even on the development of a major system program, calculating their profit from a stable configuration during production. (Phoncon Bell-Boeing Supervisor Naval Requirements and Marketing Director, 1991) A goal of the government's acquisition strategy is equitable distribution of risk. As such, specific contract types are used for each stage of procurement development relative to perceived risk. (DoD Manual 5000.2-M, 1991, pp. 22-1 - 22-1-2)

When Secretary of the Navy John Lehman directed a fixed price contract for the V-22, the Navy gained near-term savings. Fixed price contracts shift the risk from the government to the contractor. However, industry cannot afford to accept all the risk for a development program like the V-22. Therefore, if the government is not willing to support

the technology, the airplane probably won't be built by a U.S. aerospace company. The FSD contract for the V-22 bought the Navy six airplanes (now five), plus the data rights. The contract does not include any tooling changes necessary before pilot production. The government will only have to pay up to the contracted amount for FSD - in reality only a short-term savings. (Phoncon Bell-Boeing Business Development Manager, 1991)

But if the V-22 is built, the government will ultimately pay a larger cost because of the FSD contract strategy and the decision to cancel the program. When the contract becomes "locked in," so does the technology. The purchaser receives what was contracted for, and no more. Unfortunately, rapidly advancing technology becomes reduced to suggested modification. As mentioned earlier, the Navy will now have to renegotiate the pilot production contract - obviously an expensive prospect considering previous experience.

3. Administration/Department of Defense perspective

For its part, top management at the Pentagon has remained consistent in its opposition to the V-22 program. Secretary Cheney acknowledges the capabilities of the V-22, but insists the limited mission does not offset the immediate cost. The Secretary subsequently reaffirmed his position

after the IDA study was issued[2]. As noted in Chapter IV, in support of Secretary Cheney's position, the Department of Defense Comptroller has withheld funding appropriated for procurement of the V-22. Secretary Cheney has since approved the redirection of procurement funds into R&D accounts. It is unclear whether he will abide by the language contained in the FY-92 appropriation bill if passed.

4. Marine Corps perspective

Officially, the Marine Corps must support the position of the Secretary of Defense. Privately, most Marines support the V-22 program, and when questioned by congressional committees, will speak favorably on the capabilities and necessity of the airplane[3]. The Corps stresses the need for advanced avionics to operate at night and in adverse weather. Further, they point out that helicopter technology is at its upper limit.

The Marine Corps is not in favor of the proposed mix of CH-53E/CH-60 for the following reasons. First, the CH-53E is a logistical airplane, ill-suited for combat assault. Second, the CH-60, with half the troop carrying capacity of the V-22, would require twice the number of lifts and change

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[2] The results of the IDA study are still in draft form. The Assistant Secretary for Defense, Program, Analysis, and Evaluation has chosen not to formally publish the results. This might indicate dissatisfaction with the findings.

[3] Marines are prohibited from overt lobbying for the V-22 program.

the tactical squad. Former Marine Commandant, General Al Gray, stated "...funding an aircraft to meet the Corps' medium lift needs is the most pressing issue for Marines this year" (Donnovan, Steigman, 1990, p. 4). With the Marine CH-46 well into its third decade of operation, its seems likely that this position will remain unchanged.

C. CONCLUDING COMMENTS TO THE RESEARCH QUESTIONS PRESENTED IN CHAPTER I.

This section addresses the research questions presented in Chapter I, and throughout the thesis. The research questions will be restated, followed by comments highlighting answers contained in the thesis.

1. Using the V-22 as a case example, what are the programmatic and financial implications for the Department of Defense and industry of dual-use technology?

- Dual-use technology does not play well at the Department of Defense. Synthesizing dual-use strategy with the defense acquisition process may conflict with system performance that is desired by the military departments. For the Department of Defense, dual-use technology may be a convenient but not crucial selling point.

- Defense related industries interested in dealing with the Department of Defense will continue to advance dual-use technology as a strong selling point. According to one industry analyst, all future weapon systems must have spinoff application if the program is to succeed. (Phoncon Industry Analyst, 1991)

- Indirect spinoff resulting from V-22 technology has major financial and programmatic implications. Prompt development of a civil tiltrotor by domestic industry may

generate $28 billion in export in the first ten years of availability (NASA Phase II Final Report, 1991, p. 3).

- The V-22 program has been subjected to two bad timing events, i.e., program delays and major budget reductions. Still, the V-22 program has survived because of its broad-based support for the technology it represents.

2. What does the V-22 teach us about the process of defense budgeting?

- The V-22 is a highly contentious project as evidenced by increasingly specific language found in congressional reports and attention by the media. Like most other major systems, the V-22 is imbued with traditional pork and turf issues.

- Without support by senior executives within the Department of Defense, Congress has chosen to continue funding for the V-22 program. Congressional support is bipartisan because of the value of V-22 technology to both military and commercial application.

- Long term programs such as the V-22 are subject to short term decisions, i.e., annual program/budget reviews by the Department of Defense and Congress. Funding instability resulting from these annual reviews has made long term production plans difficult. This uncertainty translates into an increase in the total cost of the program.

- Objective conclusions on the programmatic budget process are difficult. Even technically sound, efficient, and promising major system programs may not be guaranteed. While we would like to believe the "best" systems are obtained, all too often the progress/success is driven by the human element "reacting" to the current political and budgetary mood.

- The V-22 is no longer a programmatic issue. That ended when Secretary Cheney cancelled the program. The V-22 program now represents a battle between the Executive and Legislative branches over their specific defense responsibilities. Both branches are at odds over the equipment and strategy to meet the threat and the question of control over defense resources.

3. How do DoD, Congress, and contractors view the importance of potential civilian applications resulting from the V-22?

- More than half the congressional support for the V-22 is for tiltrotor technology, i.e., concern for the civil vice military application.
- For the Department of Defense, performance and capability of a major system is still the primary concern. Adoption of dual-use technology as part of the acquisition strategy has been slow.
- FAA officials are firmly convinced that tiltrotor technology may reduce congestion of national airspace, increase safety, and provide an economic boost to the economy.
- Bell and Boeing promote the civil potential of the V-22 with different levels of intensity. As described in the thesis, a commercial variant of the V-22 will require major modification.

4. Given a declining military budget, should the Department of Defense continue programs such as the V-22 to sustain the defense industrial base?

- The Department of Defense should not be expected to support all dual-use programs. There exist different motives and ways of conducting business between defense and commercial industries that prevent complete integration. However, an aerospace industry with dual-use capability provides an asset generic to all the military departments. Also, the V-22 is a special airplane because it has been designed from the ground up to satisfy missions required by all the military departments.
- Encouraging major systems with attributes similar to the V-22 airplane may prove beneficial to the Department of Defense to maximize shrinking defense dollars while maintaining a viable industrial base. This has become even more acute as the nation may rely on an increasingly larger percentage of reconstituted forces.

- Dual-use technology is not applicable to every major system. The maximum benefit from dual-use technology is gained by tailoring policy to the individual program

5. **What are the roles and relationships between the military departments, the Department of Defense, the contractors, and Congress in budgeting for the V-22?**

- Congress continues to resuscitate the V-22 program by funding R&D. The differences between the Executive and Legislative branches are not yet resolved. Still, the door is open to obtain V-22 airplanes because of language contained in FY-92 congressional committee reports that provides a politically acceptable alternative to both sides, i.e., production-like aircraft funded by R&D. Given this, the Congress may continue to support development while the Secretary of Defense may claim he has not backed down from his decision to cancel the V-22.

- Joint service programs are not a particularly strong selling point especially during lean budget times. This results from increased scrutiny by the military departments of their available discretionary funds.

- The contractors are skeptical of the Department of Defense and vice versa. In short, at stake is a credibility issue. Bell and Boeing were frightened by Secretary Lehman's decision to impose a fixed price contract. Similarly, the program sponsor at NAVAIR is concerned by recurring delays and technical difficulties. These anomalies do not enhance their relationship. However, most defense contractors realize an inherent risk when accepting government contracts.

6. **What are the programmatic implications resulting from the political competition between the Secretary of Defense and Congress and other interested parties in financial terms, and in terms of decisions on the future of the V-22?**

- The program as it stands now may result in reduced buys and stretched procurement schedules, hence, a higher unit cost[4].

- According to the Marine Deputy of Aviation, time is against the V-22 program, i.e., continued delays increase the likelihood that the airplane **will not** be in the Corps' inventory. This uncertainty is a negative impact for Marine Corps warfare planners as they seek a replacement for the CH-46 to complement existing equipment and doctrine.

- The aerospace industry awaits the outcome resulting from military operational testing of the V-22 before aggressive development of a civil airplane. The FAA's proactive posture toward tiltrotor technology and infrastructure is viewed by industry as a positive signal by one branch of the federal government. Still, until the V-22 has recorded more hours of flight time, it is unlikely a civil airplane will be developed by an American firm(s).

D. SUGGESTIONS FOR FURTHER V-22 RELATED RESEARCH

Further research may concentrate on three areas highlighted in this thesis. First, the Department of Defense seems to be in a cyclical pattern of favoring a FP contract then a CP contract, then returning again to a FP contract. Contractors, military officials, and members of Congress are perplexed by this vacillating policy. The effect on major systems is uncertainty, indecision, and ultimately a higher unit cost.

Second, teaming agreements may become increasingly prevalent as defense contractors seek to maximize resources

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[4] Because the V-22 can carry more combat assault Marines than the CH-46, less deck space will be required on amphibious ships; therefore, Congress has directed the Department of Defense to look into the potential savings from reduced ship procurement offsetting the cost of V-22 buys.

and enhance their ability to secure a government contract. The relationship between "teamed" defense contractors requires that a myriad of issues be addressed and understood up-front.

Finally, the writing of this thesis concludes during a period that will become pivotal to the realization of a V-22 airplane in our nation's defense inventory. Assuming the Executive and Legislative branches resolve their differences, and technical difficulties do not become "showstoppers," the first V-22 may be in the Corps' inventory around 1996. Therefore, continued documentation of the ongoing competition and potential production of the V-22 is needed because of the unprecedented position the Congress has chosen to take in support of the program.

APPENDIX A[1]

Chronology of V-22 Events

Dec 1958. Bell Helicopter's XV-3 makes first in-flight conversion from helicopter to fixed wing airplane.
- Boeing Helicopter's VZ-2 tiltwing makes maiden flight.

Dec 1972. NASA and Department of Army (DOA) award Bell Helicopter a contract to develop two tiltrotor demonstrators (XV-15).

Jul 1979. XV-15 makes first in-flight conversion from helicopter to fixed wing airplane.

Jul 1981. XV-15 demonstrated at the Paris Air Show. Secretary of the Navy in attendance.

Aug 1981. Under Secretary of Defense (Research and Engineering) sends memorandum to Secretary of the Air Force and Secretary of the Navy suggesting a common solution be developed for a number of service rotary wing requirements.

Dec 1981. Deputy Secretary of Defense decision memorandum establishes the Joint Services Aircraft program (JVX). Decision regarded as approval for concept formulation - waives requirement for a Justification of a Major Systems New Start.

Feb 1982. Joint Technology Assessment Group (JTAG), comprised of all the services, gathers to consider alternative designs for JVX.

Apr 1982. Bell-Boeing Tiltrotor Team formed (teaming agreement signed the following month).

May 1982. JTAG determines tiltrotor design as preferred alternative.

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[1] Information contained in this Appendix was obtained in part, from three sources to include: Smith, Danny Roy, Thornborough, Anthony and the GAO report dated 1986. Please refer to the List of References.

Jun 1982. The three Service Secretaries sign a Memorandum of Understanding (MOU) in support of the JVX program including development funding shares: Army 46%, Navy 42%, Air Force 12%. Shares negotiated based on estimates of overall procurement potential. DOA designated executive service.

Aug 1982. XV-15 becomes the first tiltrotor to operate from a fully combat-capable Marine assault ship, the USS Tripoli.

Sep 1982. JVX acquisition strategy approved by Chief of Naval Material.

Dec 1982. Deputy Secretary of Defense approves JVX acquisition strategy and establishes full-scale development (FSD) as the next Secretary of Defense decision point.
- Department of the Navy (DON) replaces DOA as executive service.
- Joint Service Operational Requirement (JSOR) signed. Tiltrotor design determined to be capable of performing all the services' missions.
- DON changes acquisition strategy from Fixed Price (FP) to Cost Plus (CP).
- Deputy Secretary of Defense directs JVX program to go through a Defense System Acquisition Review Council (DSARC) review for FSD.

Feb 1983. Bell-Boeing submits preliminary design proposal.
- Sikorsky drops out of design competition.

Apr 1983. Bell-Boeing awarded preliminary design contract.

May 1983: DOA withdraws from JVX program.
- Department of the Air Force (DOAF) reduces planned procurement from 200 to 80 airplanes.

Sep 1983: Defense Resources Board (DRB) approves continuation of JVX. Full funding to be included in Navy total obligational authority (TOA).
- DOA reenters program committed to buying 231 airplanes of the Marine version.

Nov 1984: Secretary of the Navy selects Osprey as airplane title.

Jan 1985: Osprey designated V-22.

Jun 1985: FSD started at Bell-Boeing.

Dec 1985: Allison selected, after competition, to develop the engine for the V-22.

Apr 1986: DSARC recommends that V-22 program continue to FSD.

May 1986: Secretary of Defense approves FSD. FSD contract awarded to Bell-Boeing.

May 1987: DOAF reduces their V-22 requirement from 80 to 55 airplanes.

Feb 1988: DOA withdraws from V-22 program to support their requirement for LHX.

May 1988: First V-22 prototype rolled out at Arlington, Texas.

Jul 1988: Program Budget Decision (PBD) for FY-89 approves sole source procurement; however, requirement for competition during production maintained.

Aug 1988: Federal Aviation Administration (FAA) and the DON sign a Memorandum of Agreement (MOA) allowing FAA to participate in ground testing the V-22 and access to technical data.

Dec 1988: Bell-Boeing submits revised proposal for 12 co-produced airplanes.

Jan 1989: Under Secretary of the Navy directs procurement using a competitive acquisition strategy.

- Allison awarded engine contract.
- Long Lead Funds (LLF) placed on contract for pilot production engines.

Feb 1989: LLF placed on contract with Bell-Boeing for 12 pilot production airplanes.

Mar 1989: V-22 No 1 makes first hover at Bell's plant in Arlington, Texas.

Apr 1989: Tentative DRB decision to cancel V-22 received. DON reclama submitted six days later. DRB cancels V-22 the following day.

- Unanimous "Sense of the Senate" resolution passed supporting restoration of the program.
- FY-90 budget submitted to Congress recommending termination of the V-22 program; hence, no funding is requested for FY-90 and out.

May 1989: Bell-Boeing announces that it has expended all obligated funds for FY-89, and that it will continue development with its own funds through the end of FY-89.

Aug 1989: V-22 No 2 makes first flight at Arlington.

Sep 1989: V-22 No 1 makes full conversion from helicopter to fixed wing mode.

Nov 1989: Congress approves and President Bush signs $255 million for continuation of Research and Development (R&D) effort; LLF are absent.

Dec 1989: Termination for the convenience of the government letters forwarded to Bell-Boeing and Allison for LLF. Funding recovered and placed on hold at DOD.
- V-22 No 4 makes first flight at Boeing's test facility in Wilmington, Delaware.

Jan 1990: President's FY-91 budget submitted to Congress with no funding for FY-91 and out.

Mar 1990: The three operational V-22's complete the 100th hour of flight test time.

Apr 1990: First three military pilots test V-22.
- XV-15 lands on the grounds of the U.S. Capitol.

May 1990: V-22 No 3 makes first flight at Arlington.

Dec 1990: V-22's Nos 3 & 4 make successful shipboard compatibility test on board the USS Wasp confirming capability of operating safely from amphibious assault ships, a key military requirement.

Jun 1991: V-22 No 5 crashes on maiden flight in Delaware.

APPENDIX B

V-22 Congressional Action
(rounded in millions of dollars)

Fiscal Year (FY)	President's Budget	HASC	SASC	Authorized in Conference
1983 & Prior	60.0		5.0	5.0
1984	104.0	85.0	53.0	43.0
1985	200.0	179.0	199.0	189.0
1986	609.0	554.0	584.0	584.0
1987	402.0	427.0	387.0	387.0
1988	470.0	480.0	480.0	488.0
1989	641.0	641.0	641.0	641.0
1990	.0	508.0	255.0	255.0
1991*	.0	603.0	238.0	403.0
1992*	.0	990.0	365.0	?

Fiscal Year (FY)	HAC	SAC	Appropriated in Conference
1983 & Prior	35.0	5.0	37.0
1984	89.0	89.0	89.0
1985	189.0	189.0	189.0
1986	570.0	584.0	582.0
1987	380.0	431.0	426.0
1988	470.0	470.0	502.0
1989	646.0	641.0	667.0
1990	508.0	255.0	255.0
1991*	603.0	238.0	418.0
1992*	625.0	165.0	?

* Figures include funding authorized/appropriated in previous fiscal years. Chapter IV provides specific details (Naval Air Systems Command, 1991).

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